Aviation Week
and Space Technology

A McGraw-Hill Publication

November 6, 1961

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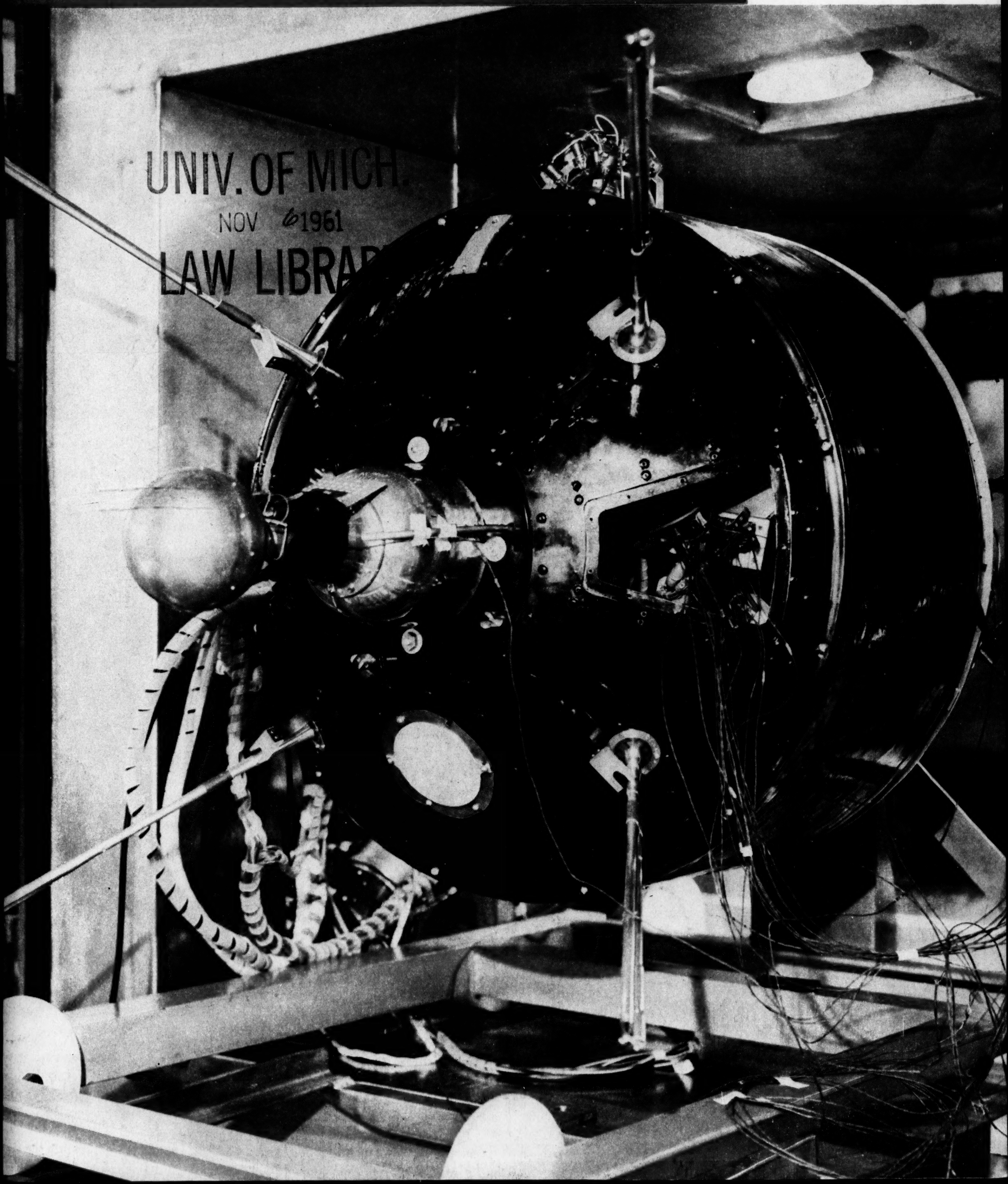
NASA Studies Astronaut's Role In Rendezvous

U.S.-British Electron Measurement Satellite



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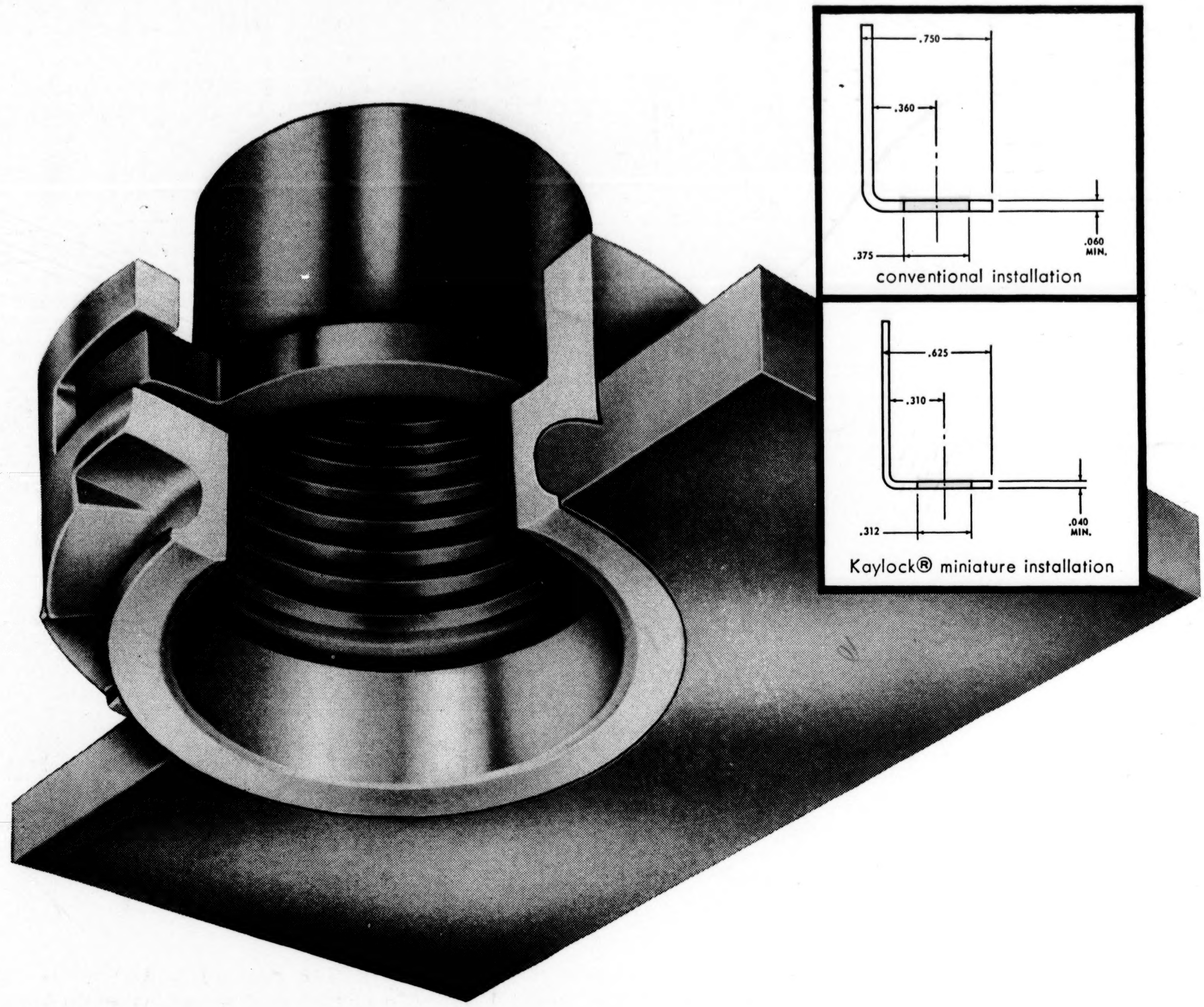

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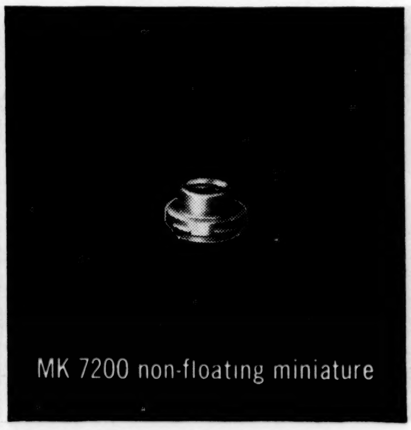
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AEROSPACE CALENDAR

Nov. 13-14—Electrically Exploded Wire Conference, Kenmore Hotel, Boston, Mass. Sponsor: Thermal Radiation Laboratory, Geophysics Research Directorate, AF Cambridge Research Laboratories.

Nov. 13-16—Conference on Magnetism and Magnetic Materials, Institute of Radio Engineers, Hotel Westward Ho, Phoenix.

Nov. 14—Symposium on Electronic Systems Reliability, IRE, Kansas City, Mo.

Nov. 14-16—Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Armory and Somerset Hotel, Boston, Mass.

Nov. 15-17—19th Annual Aerospace Electrical Society Display, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 19-22—Symposium on Biomedical Aspects of the Space Sciences, University of California at Los Angeles, Los Angeles, Calif. Sponsors: Brain Research Institute, UCLA; Air Force Office of Scientific Research.

Nov. 19-24—Medical and Biological Problems in Space Flight Conference, Nassau, Bahamas.

Nov. 27-Dec. 1—Army-Industry Aviation Logistics Symposium, Congress Hotel, St. Louis, Mo.

Nov. 28-30—38th Meeting, Aviation Distributors and Manufacturers Assn., Jung Hotel, New Orleans, La.

Nov. 30-Dec. 1—12th National Conference, Institute of Radio Engineers' Professional Group on Vehicular Communications, Radison Hotel, Minneapolis, Minn.

(Continued on page 6)

AVIATION WEEK and Space Technology

November 6, 1961

Vol. 75, No. 19

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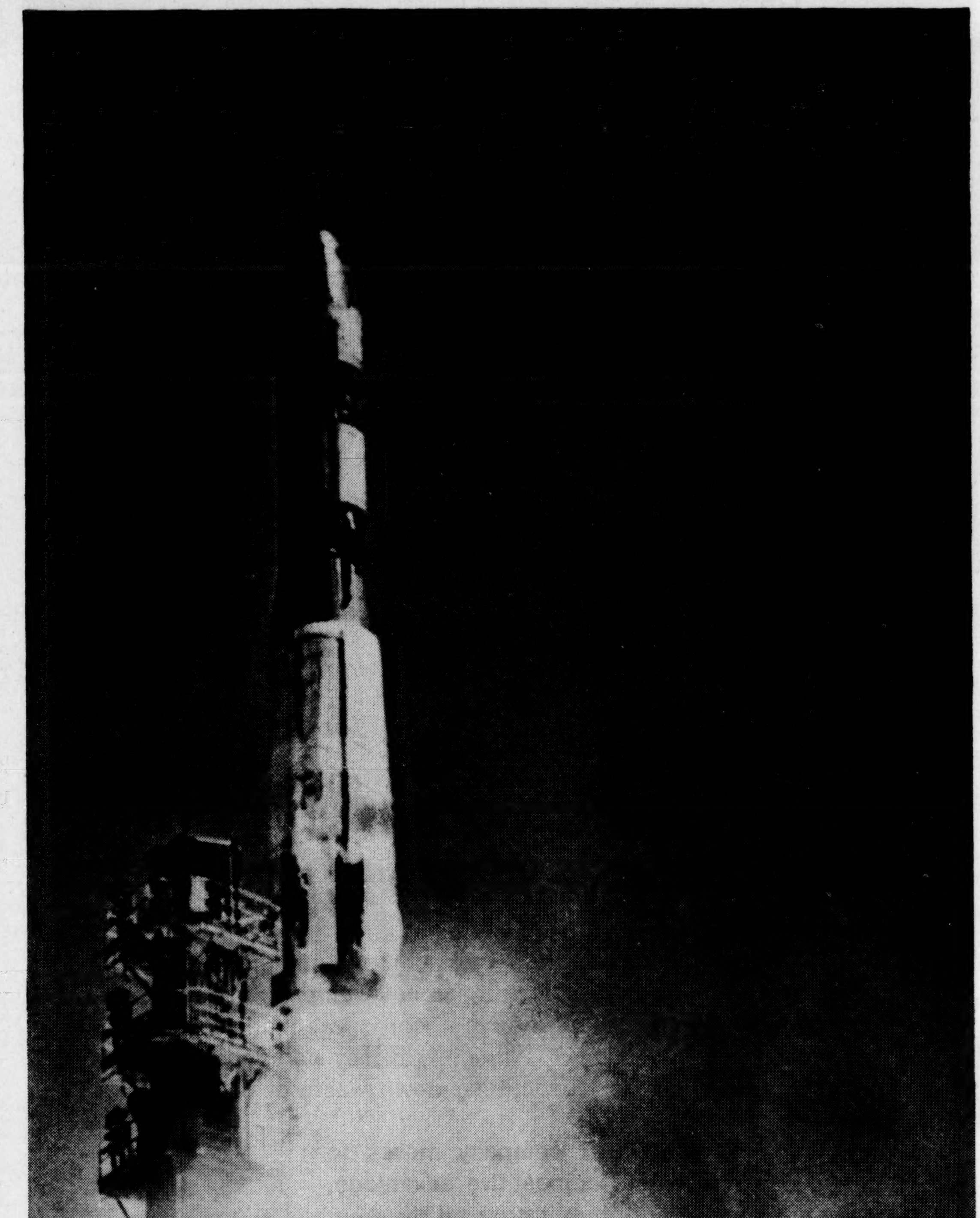

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AEROSPACE CALENDAR

(*Continued from page 5*)

Dec. 4-5—Beryllium Metallurgy Conference, New York University's Washington Square Center, New York, N. Y.

Dec. 5—11th Annual Meeting, National Air Taxi Conference, Statler-Hilton Hotel, Washington, D. C.

Dec. 5-7—Annual Convention, National Aviation Trades Assn., Statler Hilton Hotel, Washington, D. C.

Dec. 12-14—Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

Dec. 18—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, U. S. Naval Postgraduate School, Monterey, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

November 6, 1961

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Rendezvous Recommended for Moon Flight....... 26

▶ Golovin Committee conclusions would make C-4 lunar vehicle, slow development of solid, liquid Novas.

Boyd Says Fare Increases No Cure-All............ 37

▶ CAB chairman calls for other solutions as airlines request variety of boosts, reductions in tariffs.

Pilot's Role in Space Maneuvers Examined......... 54

▶ NASA drawing on airplane guidance and control experience to establish basic framework for simulating rendezvous.

SPACE TECHNOLOGY

Rendezvous Urged for Moon Flight... 26
NASA Studies Rogallo-Type Landings. 29
Telemetry Confirms Saturn Success... 30
Military Space Center Interest...... 33
Michoud Discrimination Issue....... 34
Europeans Plan Space Launcher..... 34
Pilot's Role in Space Examined...... 54
LACE Feasibility Proof Sought...... 59
Scout Relays Data From Ionosphere.. 63

AERONAUTICAL ENGINEERING

Short Bros., Lockheed VTOL F-104... 28
U. S. Hover Craft Emphasis Grows... 34
Short Bros. Planning Civil Freighter.. 65
PT6 Exceeds Estimated Performance.. 74

MISSILE ENGINEERING

Transportable Bomarc Proposed..... 91

BUSINESS FLYING

Cessna Gyrocopter Plans........... 32
Cessna Sales Prospects Optimistic... 93
Light Aircraft Radical Designs...... 98
Private Lines 97

FINANCIAL

Central African Airways Lists Profit.. 89
New Offerings 89

EQUIPMENT

New Aerospace Products........... 103

AIR TRANSPORT

All-Weather Jet Landing Plans...... 33
Boyd Says Fare Increases No Cure-All 37
White House Enters Labor Dispute... 38
Sage Computers Criticized.......... 39
Panair May Need Super Caravelles... 40
SST Requests Due Soon............ 40
Anglo-French SST Team............ 40
Short-Range Jet Transport Needs.... 41
TAI Dominates Tahiti Tourist Trade.. 43
Lufthansa Favors Mach 3 Plane..... 45
TWA Reports Loss................ 45
CAB 'Use It or Lose It' Study Urged.. 49
Airline Observer 52
Shortlines 52

MANAGEMENT

Administration Stand on B-70 Funds. 28
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 34

AVIONICS

Halaby Creates Beacon Board....... 29
Data Exchange Program Yields Results 76
Semiconductor Network Gains...... 83
New Avionic Products............ 84
Filter Center 80

SAFETY

Pilots Take Stand on Safety Margins. 105

Calendar 5
Letters 120

EDITORIAL

A Dismal Pattern................. 21

COVER: Joint U. S.-British electron measurement satellite undergoes temperature and humidity testing at the National Aeronautics and Space Administration's Goddard Space Flight Center. Designated UK-1 and S-51, the satellite will be launched from the Atlantic Missile Range by a Delta vehicle (AW Oct. 9, p. 27). The 128-lb. satellite was to have been launched by the tenth Scout, but payload increased to the point where Scout cannot carry it.

PICTURE CREDITS

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EDITORIAL

A Dismal Pattern

The decision by Secretary of Defense Robert S. McNamara to withhold the $780 million voted by Congress for additional long-range bombers, an accelerated and expanded B-70 development program and an accelerated Dyna-Soar program is another chapter in a familiar dismal pattern that has hamstrung the U.S. defense effort for more than a decade.

This pattern has involved an almost perpetual conflict between the legislative and executive branches of the government over how much defense strength is really required to support the U.S. position in the international area. This conflict has persisted regardless of which political party is in control of either branch of the government. It has always found the Congress pushing larger defense appropriations than the executive branch has requested, with these increases always earmarked for strengthening the strategic nuclear forces and new weapons development in areas where Congress believed the executive branch skimped below the levels of safety.

In taking this action to impound the $780-million defense budget boost voted by Congress, Mr. McNamara is placing himself in the same pattern followed by three of the least effective secretaries of defense in the history of this post-war department.

This pattern first emerged in the fall of 1949 when the Democratic executive branch, with Harry S. Truman as president and Louis Johnson as defense secretary, impounded about $800 million in extra defense funds voted by a Republican-controlled Congress to increase the Air Force from 48 to 70 combat groups. This congressional action was led by the late Republican Senator Robert Taft. Less than a year after the Truman-Johnson action the Communists invaded South Korea. The defense budget was more than doubled to fight the Korean war and the Air Force was increased to over 100 combat groups and Mr. Johnson left the Pentagon under forced draft.

Then again in the summer of 1956 a Democratic Congress, spurred by growing indications of Soviet technical progress in jet aircraft and missiles, voted some $800 million more for accelerating and expanding the B-52 long-range bomber and KC-135 jet tanker fleet and the ICBM and anti-ICBM development programs. This money was spurned by Republican President Eisenhower and his defense secretary, the late Charles E. Wilson. A year later, in the summer of 1957, Mr. Wilson, with the support of President Eisenhower, was still concerned with pushing the defense budget downward with arbitrarily imposed dollar ceilings on each service. This was just a few months before Sputnik I provided the first public proof of the Soviet capability in space technology and about the same time that the Soviets were firing their initial ICBMs over their Siberian test range.

In 1958 a Democratic Congress initially boosted the Eisenhower Fiscal 1959 defense budget by some $816 million for strategic systems such as Minuteman and Polaris missiles, strategic airlift and Hound Dog missiles for the B-52. By the time Defense Department, President Eisenhower and his new defense secretary, Neil McElroy, re-juggled their requests, Congress had voted $1.3 billion more than the Administration was willing to use.

Now in 1961, a Democratic President, John F. Kennedy, and his defense secretary, McNamara, have followed a similar pattern in dealing with the action of a Democratic-controlled Congress. Although Mr. McNamara has been stubbornly consistent in his opposition to congressional boosting of his defense budget for bombers, it is interesting to note that the final decision to impound the $780 million extra voted by Congress was deferred until Congress adjourned for the session and its leaders in this fight were scattered to their home states. It is also interesting to note that this decision on weapons was made not only against the strong desires of Congress but also against the advice of the military leaders who have the responsibility for successfully employing these strategic nuclear delivery forces against an enemy if necessary. This too follows the familiar pattern begun by Louis Johnson and Harry Truman.

There is another element of this pattern that should be studied carefully. It is apparent from their actions during the evolvement of this pattern that the leaders of the Soviet Union place far more emphasis on what the leaders of this country do about our defense than on the public speeches they may make on its excellence and adequacy. The "cut the fat but not the muscle" policy of Truman and Johnson was followed shortly by an outburst of armed Communist aggression in Korea.

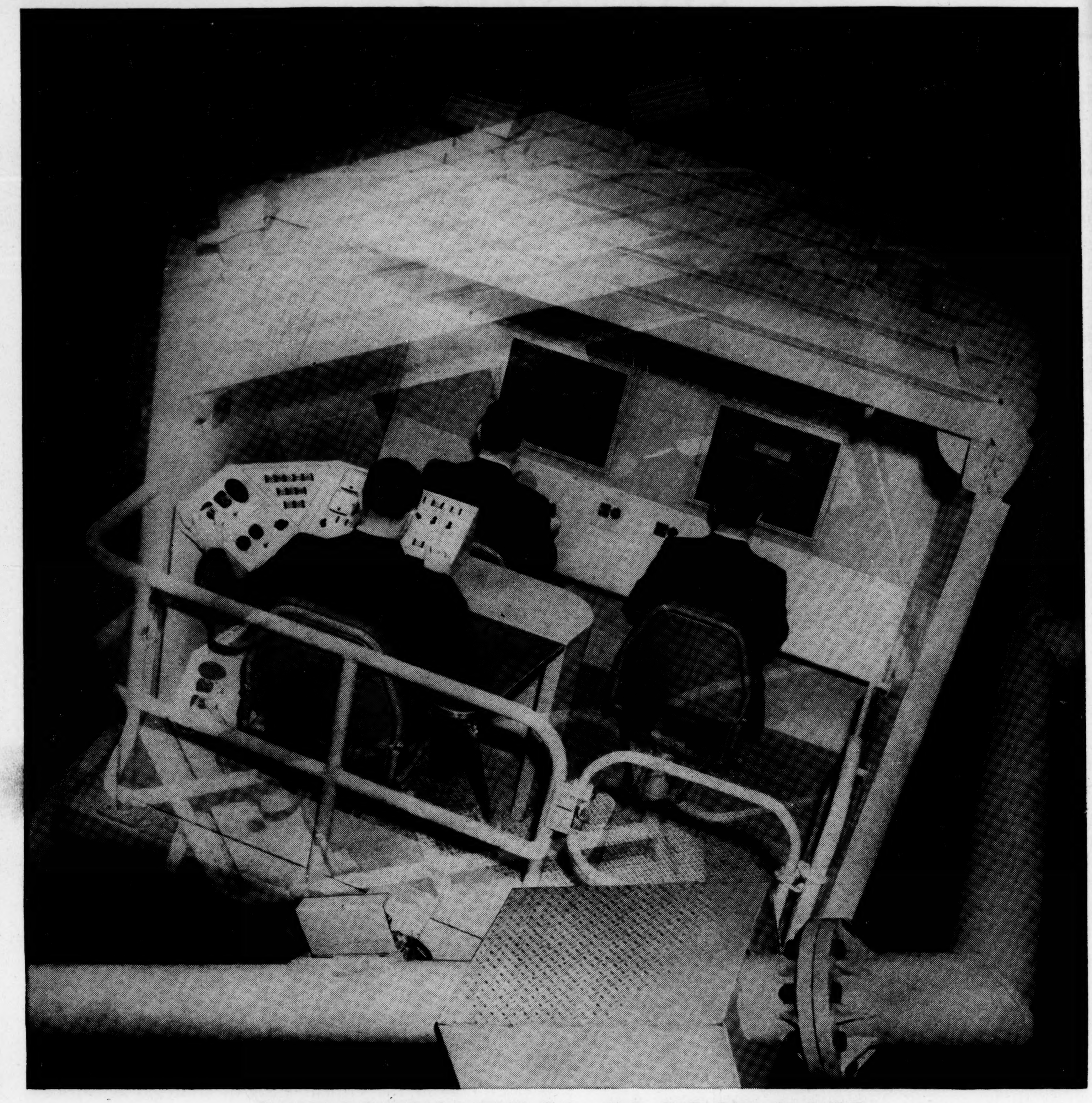
The pathetic concern of the Eisenhower Administration with holding defense budget ceilings, when a technological revolution in supersonics, missiles and space technology was erupting underneath it, certainly contributed to the increasingly tough Soviet line that has reached a crescendo, but certainly not a climax, in the current Berlin situation.

It may be equally hard for the Soviet leaders to be convinced of this nation's determination to continue to stand for what it believes to be right, even in the face of the risk of war, if our leaders can still squabble over $780 million in the critical areas of strategic aerospace power with our survival at stake.

The inexorable march of history has proved, in retrospect, that Congress has made far wiser decisions on defense policy and weapons strength than have the President-defense secretary combination in both Democratic and Republican administrations. In fact the defense budget economies of Messrs. Johnson, Wilson and McElroy have proved to be expensive errors. This may be due in part to the fact that congressional leaders on defense issues have for the most part had long years of experience in this field, while each new defense secretary comes fresh to the mark with little or no experience in military affairs and charged with a mission by his President to "save money" and show the Pentagon who is really boss.

Now Mr. McNamara has made his decision, with President Kennedy's private if not public support, to follow the pattern of his predecessors. History alone will prove the wisdom or error of his choice.

—Robert Hotz



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WHO'S WHERE

In the Front Office

J. Donald Rauth, a vice president of The Martin Co., has been named director of all Martin ICBM and space booster programs, with offices in Denver, Colo. **Dr. Ralph D. Bennett** has been named a vice president and succeeds Mr. Rauth as general manager of Martin's Nuclear Division, Baltimore, Md.

Joseph H. Schlessel, president and general manager, Western Design & Electronics, division of U. S. Industries, Inc., Goleta, Calif., succeeding **Hugh C. Bream,** resigned.

Jean Cahen-Salvador, president and general manager of Nord Aviation, Paris.

Robert B. Forrest, president and general manager of Indies Air, Inc.

Morten S. Beyer, vice president in the Washington, D. C., offices of Riddle Airlines, Inc.

Arthur L. Powers, corporate controller, Hoffman Electronics Corp., Los Angeles, Calif.

Maj. Gen. Clyde H. Mitchell will succeed **Maj. Gen. James Ferguson** as vice commander, Air Force Systems Command. Gen. Ferguson will become deputy chief of staff, research and technology, Air Force headquarters (AW Oct. 16, p. 35).

Honors and Elections

Abe Silverstein, director of the National Aeronautics and Space Administration's Lewis Research Center, has received NASA's Outstanding Leadership Award for formulating and implementing NASA's space flight program and for developing the agency's space flight centers. Formerly, Dr. Silverstein was director of Space Flight Programs (AW Oct. 2, p. 32). **William J. O'Sullivan, Jr.,** assistant to the chief of the Applied Materials and Physics Division at Langley Research Center, has received NASA's Exceptional Scientific Achievement Award for his inflatable space vehicle concepts, and for development of the Echo I passive communications satellite.

John F. Sutherland, manager-aircraft services for McDonnell Aircraft Corp., has been named chairman of the Aerospace Industries Assn.'s newly formed Product Support Committee. **Arnold R. Beckhardt,** product support manager for the Federal Systems Division of International Business Machines Corp., was named vice chairman.

Ron Brown, president of the Flight Engineers' International Assn., has been elected president of the International Technical Institute of Flight Engineers.

Solomon Lefschetz, director of the Center for Differential Equations at RIAS, and **Elmer Verner McCollum,** professor emeritus of bio-chemistry at The Johns Hopkins University, have been named foreign members of the Royal Society of London, the world's oldest Academy of Sciences.

Dr. Samuel Herrick has been appointed Jerome Clarke Hunsaker Visiting Professor of Aeronautical Engineering at Massachusetts Institute of Technology for 1961-62. Dr. Herrick will be on leave of absence as Professor of Astronomy at the University of California at Los Angeles.

(Continued on page 110)

INDUSTRY OBSERVER

▶ Major advance in semiconductor technology is expected to result within a year in transistors that can produce 10-db. gain at frequencies as high as 10,000 mc. This will represent a five-fold advance in maximum operating frequency and open a number of new applications, particularly in space communications.

▶ Bidders' briefing on USAF's medium-range ballistic missile (MRBM) probably will be held at the Ballistic Systems Division later this month. Initial version of the 1,000-mi., astro-inertially guided missile is expected to be truck-mounted and intended for use in Europe. BSD system planners recently briefed top Defense Department officials, and Aerospace Corp. already has familiarized industry with the system's general requirements. The system will require secure communications and will have to determine its position precisely wherever it moves.

▶ Army intends to use a radioisotope miss-distance indicator to judge the success of Nike Zeus anti-missile missiles launched from Kwajalein next summer against Atlas warhead targets launched from Vandenberg AFB, Calif. Indicator is being developed for Army Rocket and Guided Missile Agency by Giannini Controls Corp. under contract from Bell Telephone Laboratories.

▶ Joint industry program aimed at improving reliability of all types of aerospace and other mechanical components may be initiated by Battelle Memorial Institute. It would be modeled after a similar Battelle program with avionic components (AW Jan. 25, 1960, p. 67). Companies would invest fixed sums annually in return for Battelle's coordinating and analytical services.

▶ Jet Propulsion Laboratory is considering adding a small, lightweight roving lunar vehicle to one of the later vehicles in the Surveyor series if earlier Surveyor vehicles meet their initial objectives and funds are made available. Light rovers which could go piggyback on Surveyors have been proposed by Space-General Corp., General Dynamics/Astronautics and Ford's Aeronutronic Division (AW Oct. 2, p. 52).

▶ USAF is concerned over possible disruption of its ballistic missile capability by the electromagnetic effects of nuclear explosions. These effects exceed the range of blast and heat damage. Fields created by nuclear blasts might induce spurious currents in cables connecting control centers and missile emplacements or scramble magnetic elements of the missile such as guidance computer drums. Attempts to solve the potential problem will include more effective shielding, circuit design and layout of missile sites.

▶ Reaction time for launching of Titan IIs, which will use storable hypergolic fuels, from inside of silos may be well under two minutes, compared with about 15 min. for the Titan I, which is raised to the surface by elevator after being fueled in the silo.

▶ Pratt & Whitney LR-115 liquid hydrogen rocket engine, which will power Centaur and some stages of Saturn, recently was fired successfully seven times at P&W's Florida site, for a total of 63 min. burning time. Longest run was 12 min. and several others approached 10 min. Tanks required six refuelings.

▶ Snap type plutonium-powered thermoelectric generator used in Navy's Transit IV-A satellite is operating successfully after three months in orbit and two switchovers from it to the standby solar cell power system and back again. Quality of signals transmitted several weeks ago indicated deterioration of the Snap power supply. Satellite was switched to standby power but this produced no improvement. After a second switchover, project personnel concluded that the difficulty had come from temporary propagation.

▶ Problem that caused the failure of Discoverer XXXIII and delayed launching of the Ranger 2 is believed to have been a pump in the hydraulic system. Telemetry from the Discoverer vehicle indicated surges in hydraulic pressure and a premature shutdown of the engine.

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Washington Roundup

USAF Space Stand

The unified Air Force position on space ordered by Chief of Staff Gen. Curtis LeMay has been prepared and was presented last week to top Defense Department civilians, including Secretary Robert McNamara. The study, prepared after extensive pulling and hauling within the service (AW Sept. 11, p. 21), is in the form of a document covering what Air Force thinks it could do in space over the next 10 years.

Completion of the study comes amid an increasing clamor for a larger space role for the services, but several influential members of Congress are chary of any plans that might expand the military role at the expense of the National Aeronautics and Space Administration. Chairman George P. Miller of the House Science and Astronautics Committee, for example, is keeping a close watch on the military-civil space situation and says he will fight any encroachment on NASA's territory. He intends to press for more emphasis—not less—on peaceful applications of space technology. The division of responsibility between the services and the civilian agency is expected to become a major debating topic in Congress next year.

Intelligence Fiddling

Air Force technical intelligence, embarrassed by some of the gaps in its technical knowledge that were revealed by the Soviet Union's air show at Tushino last July (AW July 17, p. 26), has been fiddling with the code names assigned to new Russian aircraft in a quick-fix attempt to conceal the gaps. The new Mach 2.4 Yakovlev twin-jet design, which had been carried on the Pentagon sleuths' books as the Blinder and identified as a bomber, was clearly revealed at Tushino to be an extremely long-range interceptor armed with air-to-air missiles. To cover this error, USAF has now switched its name from Blinder to Fiddler—belatedly putting it into the proper fighter-interceptor category.

USAF hastily code-named the new Mach 2 twin-jet bomber, on which it had not had information previously, the Bullshot—and then quickly canceled this name because of the obvious possibilities for typographical errors. In the interval when the bomber had no official code name AVIATION WEEK dubbed it Beauty because of its excellent aerodynamic design, and this designation now is widely used. But USAF took the Blinder code name that it had removed from the Yakovlev interceptor and quietly applied it to the Beauty. In an attempt to preserve the fiction that the Beauty came as no surprise, it is blandly saying that it had carried the Blinder code name on its roster for some years.

NASA Life Sciences

Watch for NASA to pursue its own bioastronautics program regardless of the recommendations made by the various groups now studying the problem. NASA already has decentralized its life sciences program within the framework of its latest reorganization and plans to organize specific teams to tackle specific problems, drawing on military, university and industry resources and personnel as well as on its own centers. Heads of these task forces won't necessarily be NASA personnel.

Science functions of several executive departments of the government have grown to the point that President Kennedy is considering creating assistant secretaries for science. Discussions on establishing such a post within the Commerce Department, which includes the Weather Bureau, the National Bureau of Standards and the Coast and Geodetic Survey, are well along. Other departments likely to have science secretaries—Agriculture, Interior and Health, Education and Welfare.

Western Europe's annual investment in air transportation will grow from 1956-60 average of $300 million to $500 million by 1970, an increase of 67%, according to estimates in the Twentieth Century Fund's recently published study, "Europe's Needs and Resources."

Brown's New Role

Recent speech of Dr. Harold Brown, defense director of research and engineering, at the Naval Research Laboratory (AW Oct. 30, p. 26) was the beginning of a program to make more outside appearances. Brown, who is 34, has been hemmed in and frustrated by old political pros in the Pentagon but is catching on rapidly. He believes that the cost effectiveness approach to weapon systems is causing some mistakes and that technical considerations are being given too little emphasis.

In spite of Secretary McNamara's comment that Dyna-Soar is still undergoing re-examination (see p. 28), Pentagon observers expect no short cuts or major changes now that the extra funds voted by Congress have been impounded.

With the Pentagon continually tightening the lid on public information, visitors these days are being greeted with the query: "Are you cleared for unclassified?"

—Washington Staff

Rendezvous Is Urged for Moon Flight

Golovin Committee conclusions would make C-4 lunar vehicle and retard development of solid, liquid Novas.

By Edward H. Kolcum

Washington—Rendezvous technique as the quickest way to place a manned spacecraft on the moon is being recommended by the Large Launch Vehicle Planning Group, which is now completing a written report of its conclusions for the Defense Department and the National Aeronautics and Space Administration. Some conclusions were reported orally to top space officials last week.

The rendezvous decision—which automatically strengthens the position of liquid rockets—was made unanimously. The group, also known as the Golovin Committee, was made up of Air Force, Navy, NASA and Aerospace Corp. representatives. If its recommendations are accepted, a number of decisions on large launch vehicles—some of which have been pending for as long as five months—can be made. Among the most immediate:

- **The C-4 launch vehicle** would be developed on a top-priority basis. The Golovin Committee sees the C-4 as the rendezvous launch vehicle, since it could carry 200,000 lb. into a 300-mi. earth orbit and two launches would be sufficient for the Apollo manned lunar landing mission. This vehicle would be a four-barrel cluster of Rocketdyne F-1 engines, each developing 1.5 million lb. thrust.
- **Nova vehicle development,** in both solid and liquid propellant configurations, would be done at a much slower pace than had been anticipated. Nova had been proposed for direct ascent to the moon and therefore was the competitor of the rendezvous approach. The solid propellant version is to have a cluster of motors of at least 240 in. dia., with a liftoff thrust of 20 million lb., for a booster. The liquid Nova is to have a booster using a cluster of eight F-1 engines and developing 12 million lb. thrust.
- **The C-3 vehicle concept** would be scrapped, since NASA has decided it will not build both the C-4 and the C-3. The C-3 is a cluster of two F-1 engines.
- **Facilities preparation** for the C-4 vehicle could be started at Michoud, La., where vehicles will be fabricated; at Pearl River, Miss., where they will be static tested, and at the Atlantic Missile Range, where they will be launched.
- **Titan III** would be used as the launch vehicle for the orbital Dyna-Soar vehicle. Titan III is a Titan II vehicle with solid assist rockets strapped to the booster stage.

Upper Stages Pacing Item

The pacing item for these systems, as it is with the Saturn C-1 (see p. 30) is upper staging. NASA favors high energy hydrogen-oxygen propellant systems, such as the 200,000 lb. thrust Rocketdyne J-2 stage, and a Y-1 second stage, which would develop 1.2 million lb. thrust (AW Oct. 23, p. 27).

The committee, named for its chairman, NASA's Dr. Nicholas E. Golovin, was in session for 90 days, basically to study the alternatives and to make a recommendation on the quickest way to beat Soviet Russia in landing a manned spacecraft on the moon. The conclusion was that rendezvous with the C-4 vehicle gives the U. S. the best chance to perform the mission first.

Dr. Golovin and Dr. Lawrence Kavanau, special assistant for space in the Office of Defense Research and Engineering, last week briefed Dr. Robert C. Seamans, Jr., NASA associate administrator, and John H. Rubel, assistant secretary of defense, on the committee's conclusions. They will brief James E. Webb, NASA administrator, and Dr. Harold Brown, director of defense research and engineering, probably this week.

The decision on rendezvous is probably one of the few specific recommendations that will come from the committee. There will be no minority reports, and the printed conclusions will reflect a composite viewpoint. Task of the committee basically was to define a family of vehicles which will serve both military and civilian requirements for large payloads in the foreseeable future. There was some dissent on many issues—principally on which agency should manage which projects.

Split on Agency Lines

Early discussions within the Golovin Committee were marked by a division of interest along agency lines, with USAF favoring solid propellants and NASA pushing liquids. Aerospace Corp., technical manager for USAF's space systems programs, heavily favored high-energy liquids with solid assist rockets. This concept has emerged as the Titan III vehicle, a Titan II with two 120-in. dia., five-segment solid propellant motors strapped to the sides.

The Golovin Committee has recommended approval of USAF's program to begin development of the 120-in. dia. solid propellant booster program (AW Oct. 30, p. 22). USAF last week apparently made a firm decision to use Titan III as the Dyna-Soar booster, although Saturn C-1 is in a good com-

UAC Solid Division

United Aircraft Corp.'s directors have authorized creation of a Solid Rocket Division that would handle any volume production of solid motors required by UAC's subsidiary, United Technology Corp.

Production plant probably would be located in central Florida, near Cape Canaveral. All major solid rocket companies have been surveying potential production sites on major waterways and particularly in the Cape area.

United Technology handles solid propellant research and development and has limited production facilities at Sunnyvale and Coyote, Calif. Several large solid propellant development and production competitions, including motors for a medium-range ballistic missile, assist motors for a Dyna-Soar booster, and motors for a Nova booster, have been delayed pending the report of the Golovin Committee (see story).

Hybrid Rocket Research

Northrop's Norair Division is attempting to determine the feasibility of a high performance hybrid rocket engine for advanced medium- and long-range ballistic missiles.

First scale model will have a cylindrical liquid fuel tank in the center of the engine. A layer of solid propellant will be bonded to the outer surface of this tank, and another layer of solid will be bonded to the inside of the motor case. The two layers will be separated by an annular void. Four nozzles from the liquid fuel tank will create a fine, high-velocity spiral spray in the annular void, where the liquid will react hypergolically with the solid.

Plug nozzle probably will be used. Final configuration of the engine may be about 4 ft. in diameter and 11 ft. long. Rocket Power, Inc., is helping Norair with formulation of propellants.

50-Megaton Blast Tops Soviet Nuclear Test Series

Washington—High point of the Russian nuclear test series which began Sept. 1 came Oct. 30 when an explosion in the Novaya Zemlya area generated what the Atomic Energy Commission estimated at 50 megatons—equivalent to 50 million tons of TNT.

The blast, the 28th reported by AEC up to late last week, was comparable in force to the explosion of Krakatoa volcano which erupted in the Sunda Strait, East Indies Aug. 27, 1883.

Soviet Premier Khrushchev stated that the yield was greater than the 50-megaton goal. Atmospheric wave disturbances set off by the explosion were twice as strong as those created by the estimated 25-megaton explosion of Oct. 23 and lasted 20 min. longer.

The Soviet tests continued late last week with two explosions reported Nov. 1, although Khrushchev had said the 50-megaton blast would end the series.

U.S. scientists believe Russia could not possibly have had time to instrument all the nuclear test explosions it has conducted. In addition, the shots have been fired regardless of the weather, which has included some of the worst imaginable for nuclear weapons testing and resulted in Soviet territory being liberally sprinkled with fall-out.

The only conclusion that can be reached, they say, is that the Russians have "put on a fabulous show," aimed as much at political effect as gaining technical knowledge.

Despite congressional demands that the U.S. resume nuclear tests in the atmosphere, President Kennedy authorized a statement issued by Arthur H. Dean, chief U.S. negotiator on nuclear matters, which said: "Despite the Soviet series of tests, the United Kingdom and the United States are still prepared to sign immediately or to negotiate a nuclear test ban treaty right away or in the very near future, just as soon as possible, with the Soviet Union."

Since the U. S. resumed nuclear tests, the four conducted up to late last week were fired underground. Of the 28 reported Russian tests, all but one were fired in the atmosphere. President Kennedy has indicated that not all Russian tests have been reported in order to keep from revealing U. S. detection capabilities. The Russian tests were listed by the Atomic Energy Commission as follows:

- Sept. 1. Semipalatinsk area, Central Asia. Yield in the intermediate range.
- Sept. 4. Semipalatinsk. Low kiloton range.
- Sept. 5. Semipalatinsk. Low to intermediate range.
- Sept. 6. East of Stalingrad. Low to intermediate range.
- Sept. 10. Novaya Zemlya area, north of European Russia. Several megatons.
- Sept. 10. Novaya Zemlya. Low to intermediate range.
- Sept. 12. Novaya Zemlya. Several megatons.
- Sept. 13. Semipalatinsk. Low to intermediate range.
- Sept. 13. Novaya Zemlya. Low to intermediate range.
- Sept. 14. Novaya Zemlya. Several megatons.
- Sept. 16. Novaya Zemlya. About a megaton.
- Sept. 17. Semipalatinsk. Intermediate range.
- Sept. 18. Novaya Zemlya. About a megaton.
- Sept. 20. Novaya Zemlya. About a megaton.
- Sept. 22. Novaya Zemlya. About a megaton.
- Oct. 2. Novaya Zemlya. About a megaton.
- Oct. 4. Novaya Zemlya. Several megatons.
- Oct. 6. Novaya Zemlya. Several megatons.
- Oct. 8. Novaya Zemlya. Low range.
- Oct. 12. Semipalatinsk. Low to intermediate range.
- Oct. 20. Novaya Zemlya. Several megatons.
- Oct. 23. Novaya Zemlya. Possibly as large as 50 megatons, more probably about 25 megatons.
- Oct. 23. Underwater, just south of the island of Novaya Zemlya. Low range.
- Oct. 25. Novaya Zemlya. In the intermediate to high range, probably less than a megaton.
- Oct. 27. Novaya Zemlya. Low to intermediate range.
- Oct. 30. Novaya Zemlya. About 50 megatons. Fired at 12,000 ft.
- Nov. 1. Novaya Zemlya. Several megatons.
- Nov. 1. Novaya Zemlya. Low to intermediate range, probably below a megaton.

Four U.S. tests, conducted underground, are as follows:

- Sept. 15. Nevada test site. Low range.
- Sept. 16. Nevada test site. Low range.
- Oct. 10. Nevada test site. Low range.
- Oct. 29. Nevada test site. Low range.

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petitive position from a development timing standpoint.

Although there is sharp division on the merits of Dyna-Soar within the Air Force and in the Pentagon, some Air Force supporters feel its greatest contribution is to get the Air Force back into large booster development, for which it must have a mission-oriented program.

USAF Solid Projects

The Air Force solid propellant program will also consist of a three-segment motor, 156 in. in diameter, which could be used for missions previously programed for the C-3 configuration both by USAF and NASA; and motors of up to 40 in. for use in a medium-range ballistic missile (MRBM) (see p. 23).

Undetermined is the pace and future funding for the solid Nova, which Air Force Systems Command's Space Systems Division is to develop under NASA specifications. The division has been awaiting the Golovin report before awarding hardware contracts. Air Force is expected to use three contractors at least for early phases of this work. The liquid Nova, based on the same Rocketdyne F-1 engine as C-4, had not progressed beyond the point of feasibility studies.

The rendezvous decision will not meet with universal support because there are many who feel that direct ascent would be easier and that vehicles for this mission could be developed more quickly.

Some feel the ideal lunar launching vehicle should be a large solid booster stage, a hydrogen-oxygen second stage and a fluorine-hydrazine third stage. The decision, however, was based on selection of systems which could become available soonest.

The committee went beyond a general survey of the large vehicle program into cost estimates, technical management resources, research required and reliability of alternate approaches.

The complete report is not expected to be printed for several weeks, but committee members see it as a useful document for long-range planning both in the Air Force and the civilian space agency.

Group Members

In addition to Golovin and Kavanau, the planning group members were Navy Capt. Levering Smith, Bureau of Weapons; Col. Otto Glasser, and Lt. Col. David Carter, USAF Systems Command; Milton W. Rosen and Eldon Hall, NASA headquarters; Frank Williams and Wilson Schramm, NASA's Marshall Space Flight Center; H. J. Weigand, scientific adviser to the USAF deputy chief of staff for systems and logistics, and Edward Barlow and Warren Amster of Aerospace Corp.

Rand Corp. consultants assisted the group in cost analyses and resources studies.

Kennedy to Stand Firm on Bomber Funds

By Larry Booda

Washington—Kennedy Administration is prepared to stand firm on its intention to impound the extra funds voted by Congress for long-range bombers, the B-70 Mach 3 bomber and the Dyna-Soar boost glider, in spite of the strong opposition that Congress is expected to raise when it reconvenes in January.

Gen. Curtis E. LeMay, Air Force chief of staff, vigorously supported use of the long-range bomber funds during a review of the program but will now support the Administration stand.

Included in the extra funds were $514.5 million for additional long-range bombers, $180 million additional for the B-70 and $85.8 million for the Dyna-Soar. Although Congress did not specify whether the Air Force should buy the Boeing B-52 or the Convair B-58, Gen. LeMay wanted another wing of B-52s.

Defense Secretary Robert S. McNamara, in explaining the decision, stated that the buildup of bomber and missile forces already under way "will give the nation a nuclear capability several times that of the Soviet Union."

"The decision to continue to pursue this program was reached after review with full participation of the civilian and military leaders of the Defense Department," McNamara said.

Bombers Not Obsolete

Long-range bombers are in no way becoming obsolete, McNamara said. "I am confident that the capability for defense suppression possessed by our medium and heavy bombers will be more than enough to enable these bombers to penetrate to their targets."

All U. S. bombers carry a variety of penetration aids designed to decoy infrared missiles and jam or confuse radar.

The B-52 will soon carry the North American Hound Dog air-to-surface missile operationally. Eventual replacement for Hound Dog will be the Douglas GAM-87A Skybolt air-to-surface ballistic missile. A B-52 carrying this type of missile could clear enemy defense installations from its path to a target it planned to hit with the larger weapons carried in its bomb bay, or it could attack its target with Skybolts from hundreds of miles away.

McNamara said the U. S. now has a force of 1,500 heavy and medium bombers, plus refueling tankers, that has the potential to perform its mission through the late 1960s and into the 1970s.

Defense Department once had planned to reduce its medium bomber force of Boeing B-47s from 20 to 13 wings in Fiscal 1961 and 1962, cutting the number of aircraft from 900 to 585. But with the international crises that developed early in 1961, the phasedown was halted after one wing of 45 aircraft had been deactivated. The number in service now stands at 855 aircraft plus about 90 spares. There are about 570 B-52s and 75 B-58s in the inventory.

The Eisenhower budget request for Fiscal 1962 did not include funds for B-58 and B-52 production. Holdover funds from previous years for both aircraft will be spent by late 1962, resulting in shutdown of the B-52H production lines at Boeing-Wichita by next October and the General Dynamics/Ft. Worth B-58 line next September.

B-70 Plans

In reference to the North American B-70, McNamara said: "It should continue to be pursued as a development program designed to demonstrate the technical feasibility of the aircraft structure and configuration, as well as major subsystems required at great speed and high altitude."

The Eisenhower budget request of $358 million for the B-70 was trimmed by President Kennedy to $220 million as the Fiscal 1962 portion of a $1.3-billion program extending through 1965. Congress increased this by $180 million to a total of $400 million. The program without the extra $180 million will provide for the construction and testing of three prototype aircraft, one of which will be equipped with a bomb-navigation system.

First flight of the B-70 is expected at the end of 1962. The program permits continuation of essential technological development, yet retains the option of proceeding with development of the complete weapon system at a later date, McNamara said.

In the case of Dyna-Soar, the Eisenhower budget requested $70 million. President Kennedy requested an additional $30 million. With congressional additions the total became $185.8 million.

"Our conclusion," McNamara said, "is that we have already made a substantial increase in funding for Dyna-Soar which will help us solve the difficult technical problems involved in launching a manned vehicle into suborbital or orbital flight and recovering it by normal landing at some preselected site.

"We are re-examining the program. It may be reoriented so as to produce more rapidly the experience and technological capabilities relevant to presently unforeseeable needs. This will enable us to react quickly should such needs appear. If this reorientation is feasible, proper scheduling of flights and use of launch vehicles should make it possible within the funds requested for Fiscal 1962."

Throughout the controversy over the bomber funds, McNamara was able to maintain the position he took in testimony early in the last session of Congress, when he said that he did not consider additional bomber production necessary, and that if extra money was voted he would recommend that it not be spent.

By August there were indications that the reasons for his stand were an increasing Russian capability in antiaircraft defense, both in surface-to-air and air-to-air missiles and in supersonic fighter aircraft (AW Aug. 14, p. 26 and Sept. 18, p. 25). Soviet capabilities in nuclear warheads for these missiles have increased significantly.

Short Bros., Lockheed Propose VTOL F-104

London—Short Brothers and Harland and Lockheed Aircraft are designing a VTOL version of the Lockheed F-104 for the NATO V/STOL fighter competition, stressing low development cost and short time into service.

Neither firm will discuss technical details, but the proposal involved two wingtip pods, each containing four lift engines—two fore and two aft—and use of most of the F-104's existing systems.

Engines probably will be Rolls-Royce RB. 162s, which produce approximately 6,000 lb. thrust each (AW Sept. 11, p. 27), but Bristol Siddeley's pure lift engine, now in development, remains a possibility.

Shorts design team now is working on the project, using the NATO 275-mi. range specification as the prime parameter. Aircraft probably will use existing fuel tankage for the lift engines and the J79 propulsion powerplant.

Lockheed submitted a VTOL version of the F-104 to the airplane's European construction consortium—West Germany, Belgium, Holland and Italy—and stressed the airplane could be delivered in two years. Proposal also mentioned the possibility of retrofitting pods to F-104Gs in service, giving the airplane a dual role for short and long ranges.

Although the vertical takeoff version uses present systems, it would utilize a tail nozzle for stability and fine trimming. Roll and pitch control would be achieved by tilting the thrust from the podded lift engines.

Spacecraft Landing Concepts Studied

Washington—Four contractors are studying two landing concepts which the National Aeronautics and Space Administration expects to use for advanced Mercury capsules, Apollo spacecraft and Saturn booster recovery.

Now in feasibility studies, the concepts may be expanded into design contracts soon. They are Rogallo-type flexible wing, which has been under the feasibility Phase 1 study for several months by North American Aviation, Inc., Goodyear Aircraft Corp. and Ryan Aeronautical Co., and the glide-sail, under study by Radioplane Division of Northrop Corp.

North American has tested a ⅙ scale model of a paraglide system, based on the flexible wing, which has three rigid members which attain stiffness by inflation.

Both flexible wing and glide-sail devices have been tested in NASA wind tunnels at Ames Research Center, and the Radioplane system will undergo drop tests at El Centro, Calif., with boilerplate Mercury capsule models.

The glide-sail uses a steerable flap operated by ground control or from the capsule through a 28-volt motor. Tests have been made with a 41-ft. dia. parachute, with the flap area 16% of the parachute.

Halaby Creates Board to Monitor Implementation of Beacon Report

Washington—Technical advisory board headed by Richard R. Hough, director of the Project Beacon task force, has been formed to assure that the Federal Aviation Agency carries out the group's recommendations "with technical wisdom," FAA Administrator Najeeb E. Halaby announced last week.

Hough, vice president-engineering of American Telephone & Telegraph Co., discussed the Project Beacon recommendations in a talk before the fall assembly meeting of the Radio Technical Commission for Aeronautics.

Public release of the Project Beacon report is expected this week, Hough and Halaby indicated. It has been held up because of disagreement over whether FAA should adopt the Sage computers for en route traffic control service (see p. 39), a move favored by the Air Staff and the North American Air Defense Command (Norad). Hough denied reports that the report was being re-written to make it more acceptable to the Air Force. The report does urge FAA to use air defense radars which, in combination with civil radars, practically blanket the country.

Hough said that the new technical advisory group is expected to meet every month to review programs and progress of FAA's Aviation Research & Development Service (AR&DS), headed by Joseph D. Blatt, who also will serve as executive secretary to the advisory group.

The report outlines a basic traffic control philosophy, and the technical direction which system design should take. To prepare a more detailed system design plan for implementing these recommendations, Blatt said he has formed a 14-man team within AR&DS, headed by Albert Brown. Each member will be a specialist in one of eight operational or five technical areas, he said.

Many of the Project Beacon report recommendations reported by Hough at the RTCA meeting have been disclosed previously by Aviation Week (Aug. 7, p. 41; Sept. 18, p. 38).

Recommendations intended for early improvement call for separation of visual flight rules (VFR) and instrument flight rules (IFR) traffic, improved radar presentations for controllers, installation of additional file computers at traffic control centers with improved means for data entry. It also recommends that all aircraft, whether VFR or IFR, be required to contact airport approach control from prescribed distance to permit better flow scheduling.

Longer-range recommendations call for positive control IFR operations under all weather conditions above 8,000 ft. altitude along high-density airways, and above 14,000 ft. elsewhere. Also recommended is a new category of flight rule, "Controlled Visual Flight" (CVF,) for general aviation pilots without instrument ratings but with training and navigation aids that enable them to fly the controlled high-density airways.

Radar is to become the primary air traffic control tool, with radar beacons capable of automatically reporting aircraft altitude being mandatory for all aircraft that weigh more than 12,500 lb. If and when a low-cost, short-range radar beacon for general aviation becomes available, it should be mandatory for all aircraft landing in controlled airports in high-density areas, Hough said. For unequipped aircraft operating into uncontrolled airports in high-density areas, special air corridors and tunnels must be provided, with speed limits set.

Hough said that in the long run it will be more efficient and less costly for the FAA to develop its own traffic control computers rather than adopt the Sage air defense computers. Additionally, it will permit Norad to alter its Sage system configuration or operations without being constrained by FAA traffic control needs. Although computers are needed to relieve the traffic controller of much of his present clerical workload, Hough cautioned against going overboard in introducing automation into traffic control.

The report concludes that a much larger portion of military aircraft operations can be placed under FAA control when the new system is implemented, with greater joint civil-military use of areas now restricted to military operations.

Hough said the report urges continued efforts to increase the conspicuity of aircraft. He said that the task force found no feasible collision-avoidance or proximity warning systems in the near future.

The report calls for FAA to set up procedures by which it can measure the quality of its service and the gains achieved by improvement in the traffic control system.

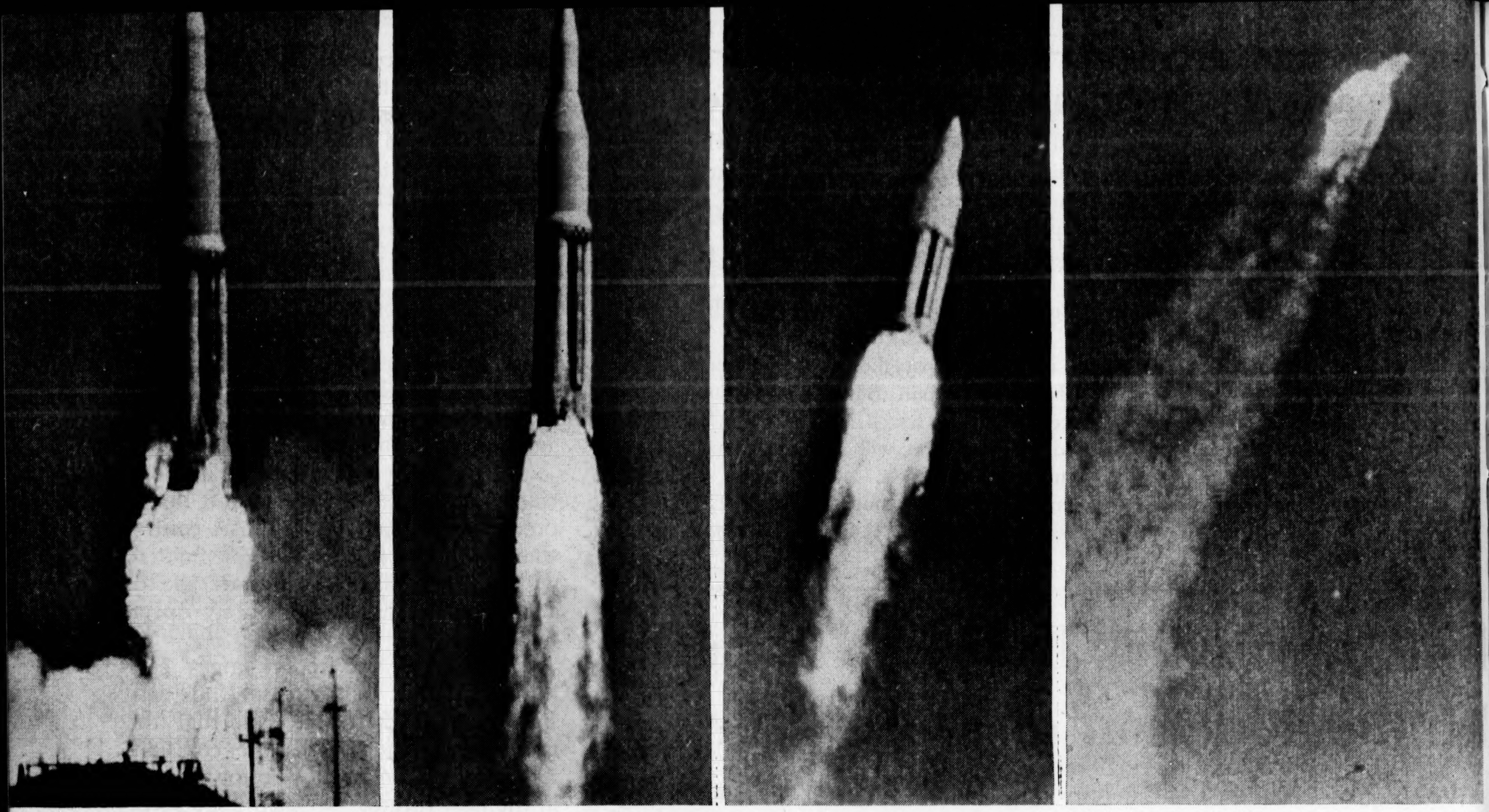
Traffic control system recommended by Project Beacon can be developed and implemented with present FAA funding, but will require a cutback on development programs which are not required for the proposed system, Hough said.

RTCA Future in Doubt

Washington—Statement by Federal Aviation Agency Administrator Najeeb E. Halaby may signal the end of the Radio Technical Commission for Aeronautics, formed 26 years ago at the suggestion of FAA's predecessor to coordinate the views of all segments of aviation and recommend solutions to avionic problems.

Addressing RTCA's annual fall assembly here, Halaby said FAA has other, more direct means to coordinate the views of interested government agencies and its doors are always open to hear the views of others. He indicated that he saw no future role for RTCA unless it can demonstrate greater leadership and capability.

The RTCA's annual budget, about $70,000, is obtained from interested government agencies and industry members. Dr. Arthur L. Lebel, present RTCA chairman and an employe of the State Department, told Aviation Week he will attempt to get RTCA members to increase their contributions to permit the hiring of a full-time chairman and larger staff.



FOUR PHOTO SEQUENCE of Saturn launch shows from left to right (1) rocket leaving its launching pad; (2) Saturn gaining speed as it becomes airborne; (3) swinging south on its 214-mi. flight down the Atlantic Missile Range; (4) releasing vapor trail as it proceeds on its course. Saturn was launched from Cape Canaveral, Fla., Oct. 27.

Telemetry Data Confirms Saturn Success

By George Alexander

Cape Canaveral—Detailed analysis of flight data from 510 on-board telemetry channels has confirmed that the Saturn booster which will test Apollo configurations and systems in earth orbit made a flawless first flight.

Saturn SA-1 was launched Oct. 27 and a first-run analysis of flight data was completed Oct. 31 at National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala.

An Apollo boilerplate configuration is to be launched as the payload of the seventh Saturn development flight in 1963. Any acceleration in this schedule depends on development of the S-IV second stage, called the pacing item by Dr. Wernher von Braun, Marshall director. The S-IV stage is powered by a cluster of six Pratt & Whitney LR-115 hydrogen-oxygen engines, which have been delayed in development (AW Oct. 23, p. 26).

Both NASA and Pratt & Whitney feel LR-115 problems have been overcome, and the engine recently had a run of seven consecutive successful firings (see p. 23). The engine is to be used in both Saturn and Centaur programs, and will make its first flight as a Centaur stage in January.

Saturn SA-1, with water-filled S-IV and a combination S-V and payload, was capped with a Jupiter nose cone. Flight analysis shows it flew 214.727 mi. and reached a peak altitude of 84.813 mi. During the last seconds of powered flight, a roll oscillation of 1.4 cps. developed from fuel sloshing, but the amplitude remained low enough so that the ballistic trajectory was not affected.

Liftoff was at 10:06:01 a.m. EST after an 11-hr. count, during which there were only two holds for weather, totaling 64 min. No technical difficulties were encountered during the count.

The eight Rocketdyne-built H-1 engines, used in the Atlas, Thor and Jupiter missile programs, were started in opposing pairs 100 milliseconds apart—outboard engines 5 and 7 first, then outboards 6 and 8, inboards 2 and 4 and finally inboards 1 and 3. Liftoff thrust later was determined to have been 1.296 million lb., a shade less than the anticipated 1.3 million lb. Maximum thrust, achieved just prior to burnout, was 1.515 million lb.

Thrust Frame Flex

As full thrust developed in 1.4 sec., the thrust frame of the powerplant flexed about 1 in., allowing four support arms to be retracted from the booster base. Four restraining arms still held the booster for 3.97 sec. as the automatic ground checkout equipment made final checks for rough combustion in the engines and pump, tank and hydraulic pressures. The liquid oxygen and kerosene cable fill-masts were ejected from the booster base, the toggle clamps in the restraining arms were released and the vehicle committed to launch. Liftoff weight of the 162-ft. tall SA-1 was 927,000 lb.

Launched on an azimuth of 100 deg., the SA-1 began to pitch over gradually on its downrange trajectory 10 sec. after liftoff. Programing continued until T+100 sec., when the vehicle was inclined 43 deg. to the launch vertical. Maximum dynamic pressure occurred at T+60 sec. at an altitude of approximately 7 mi. and Dr. Kurt H. Debus, launch operations director, had said earlier that if the vehicle successfully reached this point in the flight profile, he would consider the flight to be a "100% success." Another Marshall Space Flight Center official said that the blockhouse crew "went wild" when SA-1 passed through this critical area.

Tracking data from the ultra-high frequency doppler radars indicated that the inboard engines shut down after 109.37 sec. flight time and the outboards at 115.15 sec., both about 2 sec. shorter than programed but well within tolerances for this first flight test. Shutdown of the eight engines—at 35 mi. altitude and 19 mi. downrange—is staggered to preclude oscillations that might result from abrupt thrust termination and to permit more complete utilization of fuel.

Total flight time was 483.6 sec.; peak

velocity was 3,607 mph.; and the entire vehicle, no stage of which was separated, impacted within 7 mi. of the target area, approximately 70 mi. northeast of Little Abaco Island. Chase aircraft used to monitor and photograph the vehicle's flight included a Lockheed C-130 at 25,000 ft., a Douglas A3D at about 40,000 ft. and Lockheed U-2 (AW Oct. 30, p. 19) aircraft.

Countdown Procedure

The count began at 11 p.m. the night before launch at T-600 min. At T-570 min., vehicle power was turned on to exercise electrical circuits and components and at T-350 min., 40,000 lb. of liquid oxygen were pumped aboard the center 105 in. dia. tank and four of the eight outboard 70 in. dia. tanks for leakage checks and to cool lines, valves and tankage.

At T-270 min., the stabilized platform in the Saturn's guidance system was activated to check roll and yaw commands and at T-260 min., the vehicle briefly went on internal power to check the flight batteries.

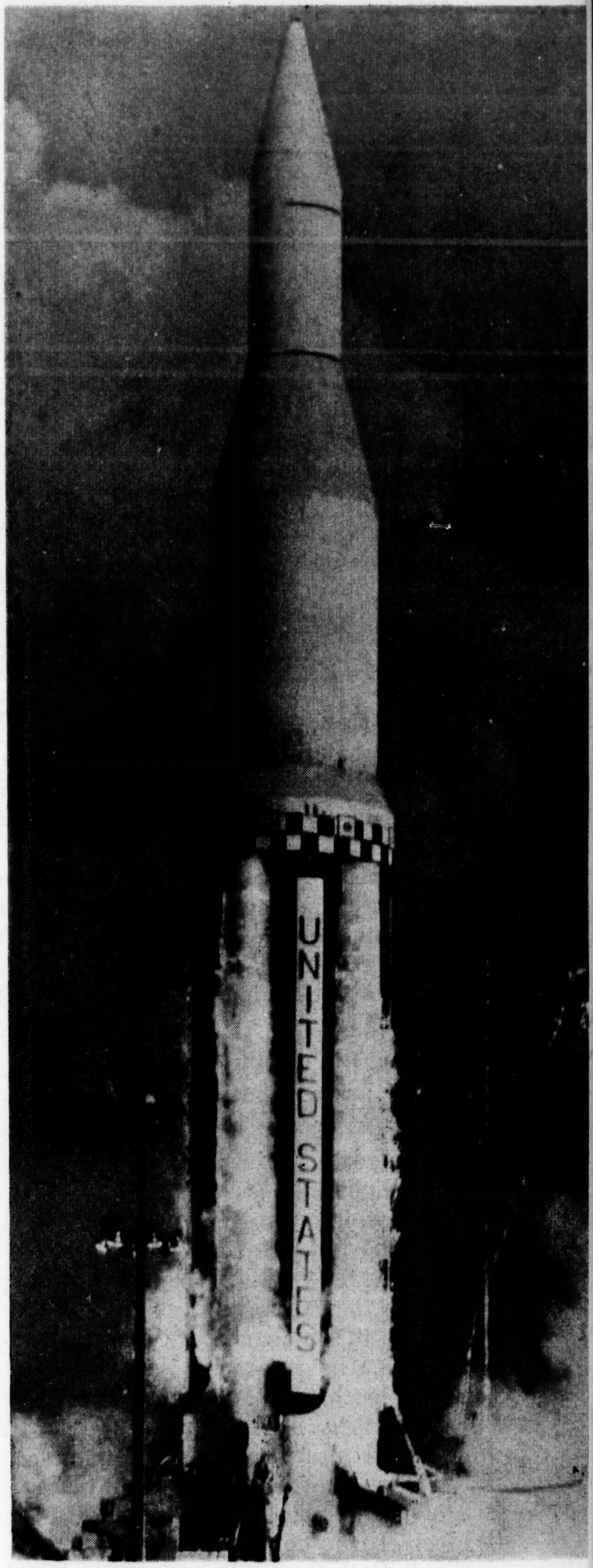
The 310 ft. tall service structure, with a 56 ft. wide slot to accommodate the Saturn vehicle, was rolled back at T-120 min. to a point some 600 ft. from the launch pedestal. The launch area was cleared of all personnel at T-80 min. and the vehicle filled with liquid oxygen from T-60 to T-30 min. Fuel, RP-1, was loaded aboard the four outboard tanks two days earlier.

The automatic sequencer went on at T-374 sec., a little before 10 a.m., EST. Monitoring tank, hydraulic and pump pressures and the performance of other systems, the sequencer commanded a nitrogen purge of the engine compartment at T-300 sec. and closed the vents of the five liquid oxygen tanks at T-120 sec. Saturn switched from external to internal power at T-35 sec.—a point of no return at which the vehicle must either be committed to launch or the flight canceled—and, at T-25 sec., the sequencer commanded ejection of the 70-ft. cable boom connected to the interstage section between the booster and the S-IV stage, where the guidance system, telemetry, programmer, transmitters and command destruct packages were housed.

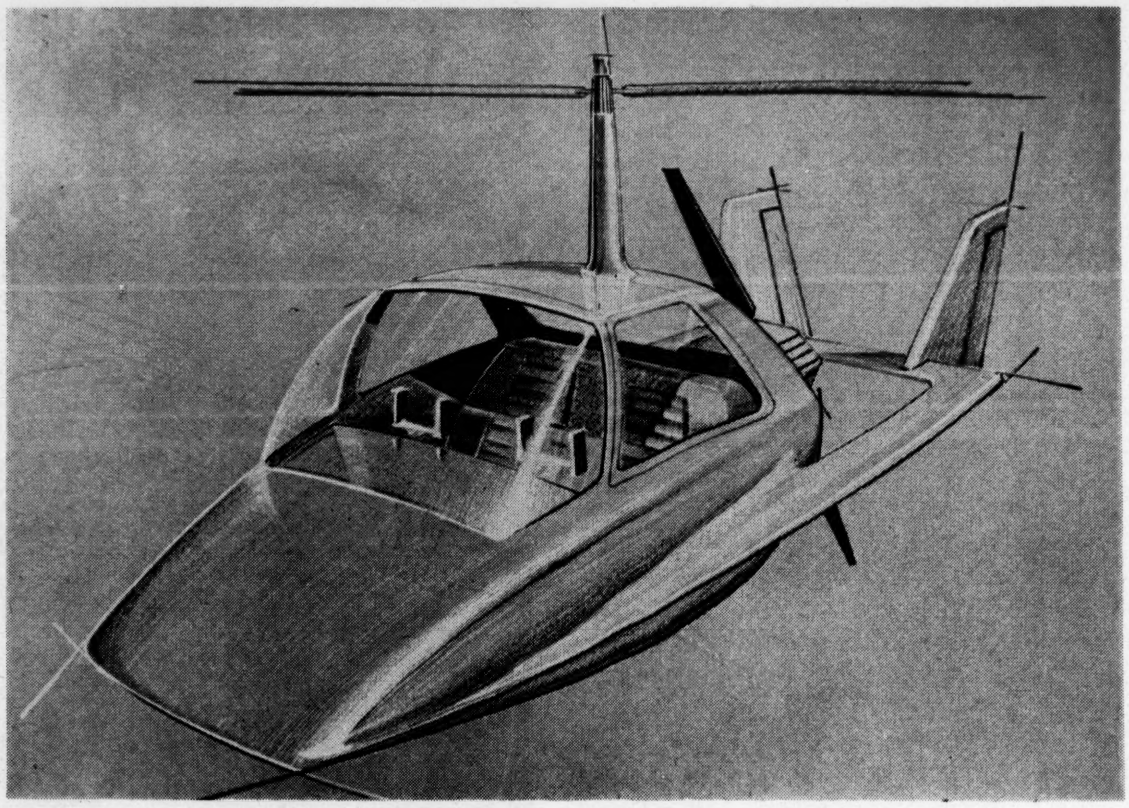
At T-00, the sequencer ordered the firing of a single solid propellant charge and the gas pressure brought the turbopump of each engine up to speed. Hydraulic valves were then opened and fuel and oxidizer were introduced into the combustion chamber simultaneously with a fluid that ignites hypergolically with the liquid oxygen. The resultant flame ignited the RP-1.

Potential problem areas proved to be less serious than Marshall Space Flight Center personnel anticipated:

- **Noise.** A total of about 50 sound readings were taken at and around the launch complex, at other points on Cape Canaveral, on Merritt Island (between the Cape and the Florida mainland) and at various locations on the mainland up to a distance of about 10 mi. from the launch complex. NASA expected about 115 db. at a distance of 2 mi. from the launch stand, 100 db. at the Cocoa Beach causeway, which connects the beach to the mainland, and about 95 db. in Titusville, north of the Cape on the mainland. NASA press releases stressed the point that these levels were well within the tolerances of the human ear and likened them to the sound intensities of power mowers, police car sirens and "the rumble of distant thunder." Newsmen at a press site 11,000 ft. from the pad were in general agreement that the noise was less than they had expected and some felt that it was less than caused by some Atlas and Titan launches. The measurements were made by Marshall Space Flight Center, the Air Force Missile Test Center, the USAF Aeronautical System Division's environmental survey team and the U.S. Coast and Geodetic Service, the last mentioned conducting ground vibration tests. Preliminary analysis last week indicated that actual sound levels were lower than those predicted.
- **Heating on the booster base.** To protect critical engine subassemblies, such as the pumps, valves, control devices and instrumentation, against the 4,500F gas exhaust, Marshall Center personnel devised a flexible heat shroud through which the bell nozzles of the eight engines protruded. Basically a glass fiber fabric with a silicon rubber, a silica fiber and a reflective coating, the curtain was designed to take up to 25g without failing. Between the curtain and the booster base, NASA installed a plastic heat shield, which was partially air-cured and cured completely during the course of inflight heating. Over the heat shield, an aluminized glass fiber cloth tape was wound to reduce radiant heat on the Saturn base below the insulation breakdown point. After loss of the tape, the shield protected all structural members for the remainder of the flight. Rocketdyne engineers indicated that a preliminary analysis of the heating data telemetered from the booster during flight showed that temperatures did not exceed anticipated levels and that all insulation stood up well.
- **Rough combustion** and engine vibration. Both NASA and Rocketdyne were concerned with the possibility of rough combustion in the H-1 engines, a condition caused by acoustics within the thrust chamber which results in the flame front dancing back and forth in front of the injector plate and occasionally striking the plate. Destructive failures are not only possible in rough combusting engines, but—if not caught quickly and the engine promptly shut down—more than probable. Rocketdyne officials declined to reveal what steps are being taken to correct this problem, but Konrad K. Dannelberg, Marshall Space Flight Center, in a report presented to the recent American Rocket Society meeting in New York, said that uprated H-1 engines would be modified by the introduction of an improved turbopump and a "new injector to reduce rough combustion tendencies at the higher thrust levels." The uprated H-1 engines, which will have an



SATURN, 162-ft. high, made a 483.6 sec. successful flight down Atlantic Missile Range.



Cessna Plans Rotary Expansion

Cessna Aircraft has indicated that it plans to expand into the light helicopter field and is studying all configurations rather than just the true helicopter, including gyroplanes, and particularly in the low price field. Company said that a two-place machine in the less-than-$10,000 bracket, with major emphasis on simplicity in construction, is being studied (photo above). Cessna would consider every possible design approach, including the "Umbaugh-type" gyroplane, Cessna Senior Vice President Del Roskam said. Roskam added that the greatest penetration in the civil market will be made by a four-place machine in the $35,000 class and that this will have to be a practical helicopter having considerable utility and not a stripped down machine. (See p. 98 for other Cessna design studies.)

individual thrust of 188,000 lb. compared with the 165,000-lb. rating of the H-1s in the first Saturn booster, are scheduled to be installed on SA-5, the fifth flight test vehicle. Presumably, the new injector and turbopump will not be flown aboard flights SA-1 through SA-4 unless, as Dannenberg said at the ARS, "the change is considered to be mandatory for the performance or reliability of the booster flight, such as the ignition monitor valve, which is being retrofitted on all delivered and forthcoming engines.

"However, the majority of the improvements will be introduced with the block II (the uprated system) configuration." Both Rocketdyne and NASA had been concerned, earlier in the program, that the vibrations of each engine would amplify the vibrations in adjoining engines and thus possibly induce structural failure, but static test firings at Marshall's Huntsville, Ala., facility disclosed that this fear was groundless.

One NASA spokesman estimated that if SA-1 had lost an inboard engine during flight, over-all vehicle performance would have been cut by about 3%. Loss of an outboard engine, he said, would have been "more serious." Debus, at a conference the day before launch, said that the Saturn "could fly and achieve a majority of its programed missions with one engine out."

First flight of a Saturn was monitored by 610 telemetry channels, 510 aboard the vehicle and 100 in the blockhouse for "quick look" analysis. The vehicle channels transmitted data on fuel and liquid oxygen levels and flow rates; engine turbine temperatures and rpm. counts; temperatures of engine bearings, heat exchanger outlets, tail skirt and turbine exhaust; pressures in combustion chambers, propellant tanks, inert upper stages; strain and vibration checkpoints over the entire vehicle; angle of attack and angular velocity; engine actuator positions and hydraulic oil levels; stabilized platform position and velocity readings; engine gimballing and battery voltages and currents.

Long focal-length cameras, to record the vehicle's flight, were situated at Patrick AFB, False Cape, Williams Point, Vero Beach, Melbourne and Cocoa Beach. The second weather hold, for 30 min., was ordered when more than half of these stations reported less than 100% visibility.

Eight radars were used to track the Saturn for range safety determination and range safety officers broke the flight into three areas of concern:

- **0 through 10 sec.,** blockhouse and immediate launch complex vicinity.
- **10 through 60 sec.,** the general Cape Canaveral reservation.
- **60 sec. to conclusion of flight,** all local areas.

The clear area for this first flight was designated as a circle with a 10,000-ft. radius drawn from the launch stand, but range safety officers indicated that this will be dropped to 5,000 ft. on subsequent flights. In comparison, the clear circle for Atlas or Titan launches is a 3,000-ft. radius.

The flight—originally scheduled for Oct. 21—had been delayed while NASA program officials reached a decision on whether more instrumentation should be added to the base of the booster to take readings on the critical bending mode that occurs between 10 and 30-35 sec. of flight. Debus said that it was finally resolved that the instrumentation already aboard the SA-1 was adequate and the flight was rescheduled for Oct. 27.

At a post-launch conference, Debus described the flight as "near perfect" and said that damage to the launch stand was "recognizable, but minor and less than expected." Another NASA spokesman estimated that it would take about a month or less to repair the pad for future launches.

SA-2, the second Saturn booster, had its final static firing on Oct. 24 and has been moved into the Quality Testing Division at the Marshall Center for a complete mechanical, electrical and hydraulic checkout and flight evaluations by computers. SA-1 spent about two months in this process. SA-2 is scheduled to be barge-transported to Cape Canaveral in January, 1962 and launched in March. SA-3 is scheduled for launch in October or November of next year and four launches are scheduled—one for each quarter—in 1963.

First flight of a Saturn with a Douglas-built S-IV live second stage, powered by six LR-115 liquid hydrogen engines with a total stage thrust of 90,000 lb., is scheduled for sometime in 1963. SA-5 will also be the first vehicle to have fins on the booster for aerodynamic stability, this addition necessitated by the elimination of the S-V stage from the Saturn C-1 configuration. The General Dynamics-built S-V stage, powered by two LR-115s, will not be flown live in the 10-launch development program. Boosters from SA-5 on are referred to as Block II units and will have a propellant increase of 100,000 lb. over the 750,000-lb. capacity of Block I boosters, SA-1 through SA-4.

SA-6 will be the same vehicle as SA-5 and perform essentially the same missions. SA-7 through SA-10, while completing the flight proving phase of the C-1 vehicle, will have the additional mission of testing prototype models of the Apollo three-man spacecraft.

In the flight of SA-1, the S-IV inert stage was ballasted with 90,000 lb. of water and the S-V stage with 100,000 lb. of water. The dummy payload was a nose section from a Jupiter IRBM and weighed slightly more than one ton.

All-Weather Jet Landing Plans Revealed

By Philip J. Klass

Washington—First details of a joint Boeing-Bendix program to improve the all-weather approach and landing capability of the 707/720 jetliners were disclosed here last week at the annual fall assembly meeting of the Radio Technical Commission for Aeronautics.

The program has three objectives, Frank C. Fickeisen told the RTCA. The most immediate is to achieve performance and reliability needed for landings under 200 ft./½ mi. visibility conditions. Next goal is a lower minimum, perhaps to around 100 to 125 ft. ceiling, and finally, automatic landing. The three programs are being carried out concurrently, Fickeisen said.

The specific areas of improvement under investigation:

- **Better lateral control,** by means of a full-time yaw damper.
- **More effective rain removal.** Using a newly constructed rain-wind tunnel Boeing already has found methods for better windshield rain clearance, Fickeisen said.
- **Integrated warning panel,** which will provide pilots with indication of operability of all vital approach aids: Localizer and glide slope receivers, and directional and vertical gyros. This will become standard on all Boeing jets.
- **Heads-up display devices,** which can be mounted near windshield to give pilot steering instructions while he looks outside, are under investigation. Boeing has installed British Smiths' Para Visual Directors for flight evaluation.
- **Split-axis control** is being evaluated, under Federal Aviation Agency sponsorship, to determine advantages of making approaches with one axis under autopilot control while the other is flown manually, and to determine which axis should be automatically controlled for best results.

The Eclipse Pioneer Division of Bendix, working with Boeing, has developed an extensive improvement program for the PB-20 autopilot used on the 707/720. It is intended to increase reliability and adapt the automatic approach coupler to presently used radar vectoring and jet penetration techniques.

Representatives of the Air Force and 17 airlines now operating Boeing jetliners recently attended a three-day briefing in Seattle on the all-weather improvement program.

Lear, Inc., has two programs under way, one with Sud Aviation and one with Air France, aimed at improving the all-weather capability of the Caravelle and eventually providing fully automatic landing, Lear's Kenneth C. Kramer told the group.

The Sud Aviation program, jointly financed by the FAA and the French Air Ministry, has these three objectives:

- **Provide automatic** throttle control and improved approach coupler control to permit lower approach minimums for the Caravelle, equipped with a Lear L-102 autopilot.
- **Provide automatic** landing computer capable of bringing Caravelle to touchdown within 250 ft. of average touchdown point.
- **Determine cockpit** instrumentation required to enable pilot to more effectively monitor low approach and automatic landing operations.

Prototype auto-throttle control and improved coupler currently are under test on a Lear B-26 and are scheduled for delivery to Sud Aviation in December for flight evaluation on a Caravelle.

The program for Air France is intended to permit immediate lowering of approach minimums to 100 ft./½ mile, by means of improvements to the existing L-102 autopilots now used on its Caravelles. Modifications to the autopilot will include a simplified type of control wheel steering, tighter path control in the approach coupler, plus the addition of eye-level indicators near the windshield to show status of system.

Another feature will be an automatic altitude hold which will automatically level aircraft when it reaches 100 ft. altitude, using signal from existing radar altimeter, in the event pilot is busy looking out and attempting to make visual contact. Present plans also call for the addition of a simplified automatic throttle control, Kramer said.

A two-year program to improve the performance and maintenance of Bendix and Sperry autopilots and flight directors used in Pan American Airways jetliners has begun to pay off, PAA's Ben F. McLeod told the RTCA. The airline's pilots have been encouraged to use autopilot approach couplers and flight directors for instrument approaches and to turn in reports on the equipment performance.

In the past six months, Pan Am pilots have turned in more than 1,100 such reports, which are carefully analyzed by airline, Sperry and Bendix engineers. Of 320 pilot reports on the Bendix PB-20, 78.5% rated autopilot-coupler performance as good or fair, while remaining 21.5% listed it as poor.

Of more than 700 pilot reports on the Sperry Z-4 flight director, used on both the DC-8 and 707, 92% rated instrument performance as good or fair. The main complaint was over-sensitivity of the roll axis steering needle which is being corrected by an instrument modification.

Independent studies have been made by Pan Am and Boeing, to determine what error in localizer tracking can be tolerated in a 707 type jetliner at minimum altitude and still enable pilot to complete landing using only a gentle corrective maneuver. Both came up with the same figures: At 200-ft. altitude, the displacement from the localizer beam should not exceed 200 to 250 ft., McLeod said.

Space Centers Picked With Eye to Military

Washington—U. S. can quickly shift the huge new facilities it is building for the civilian space program to military use if the need arises, according to James E. Webb, administrator of the National Aeronautics and Space Administration.

Webb said a national emergency was taken into consideration in locating the Houston Manned Space Flight Center, the Michoud large launch vehicle fabrication facility and its nearby test site, and the large booster launch site at the Atlantic Missile Range.

Speaking before the Washington Aero Club, Webb said the "real test" in the space program will come next year, when Congress will be asked to support NASA appropriations almost double the $1.7 billion for Fiscal 1962. There have been indications that Fiscal 1963 requests will total $3.7 billion.

He said the Eisenhower Administration gave a cost estimate of $17 billion for a 10-yr. program, and a more realistic estimate should have been $20-$25 billion. Webb added that the Eisenhower program would have required 15 years and more money to accomplish, and the new Kennedy goals—to be accomplished in 10 years at a cost of $33-$35 billion—will cost less than if spread over the 15-yr. span.

Webb also made these points:

- **Russia probably** will send a multiman spacecraft in earth orbit and on circumlunar flight before the U. S., but he believes the U. S. can beat Russia to a manned lunar landing.
- **Vital part** of the space program is maintaining the present enthusiasm of the Congress and the public.
- **More than 5,000** companies are now engaged in missile and space work, and they have developed more than 3,200 space-related products in commercial production.
- **NASA could provide** a secure passive communications satellite today with an Echo-type system.

Europeans Plan Space Launcher Activities

London—Delegations from nine countries interested in the commercial uses of space met in closed sessions here last week to hammer out proposals for a European launcher development organization.

Austria declined to participate, although Norway, Sweden and Switzerland sent uncommitted observers (AW Oct. 9, p. 27). Australia has a delegation, since launches probably will be made at the Woomera rocket test range.

The meeting is an outgrowth of the Strasbourg conferences earlier this year (AW Jan. 23, p. 34) and has been strenuously pushed by Britain and France, despite apathy and resistance by smaller nations. Sweden, for one, thinks it should have been allowed to submit a proposal for a launcher third stage, which will be built by West Germany.

The European space plan, based on the de Havilland Blue Streak as first stage and French Veronique as second (AW July 10, p. 23), still lacks specific aims, other than an agreed interest in a communications satellite. The primary task, according to Minister of Aviation Peter Thorneycroft, joint host with France's Minister of Aviation Francois de Rose, is to prepare the launcher plan "at the earliest possible date." Development cost is $200 million, of which Britain will provide a third.

Rep. Miller to Press For U.S. Hover Craft

Washington—House Science and Astronautics Committee next year will press for more U.S. emphasis on development of ground effect machines capable of carrying passengers and cargo over land and water.

Committee Chairman George P. Miller (D.-Calif.) told AVIATION WEEK his on-the-spot study of British work in this field during his recent European tour has convinced him such vehicles, which are supported by a cushion of air, could "revolutionize our transportation system."

Rep. Miller said the U.S. lagged in developing hydrofoil craft and must not let the same thing happen with ground effect machines, or hover craft. Although the committee's 1962 agenda has not been drafted, the chairman's interest is expected to lead to early hearings on U.S. progress in the hover craft field.

Great Britain has been placing heavy stress on hover craft in recent years. Jonathan P. M. Horner, Washington representative of Britain's government-sponsored National Research Development Corp., said he believes the British are "one or two years ahead of the U.S." in the field. He said Saunders-Roe Division of Westland Aircraft, Ltd. next year will test a hover craft designed to carry 68 people at a speed of 70 kt. Other British firms working on hover craft are Brittain Norman, Folland Aviation, Ltd., Vickers-Armstrongs and William Denny & Bros., Ltd.

NASA Contract Stirs Discrimination Issue

Washington—Award of a contract to Gurtler-Hebert & Co. to rehabilitate the Michoud, La., ordnance plant for Saturn and Nova booster fabrication was reaffirmed last week by the National Aeronautics and Space Administration after the award announcement became a civil rights issue here and in New Orleans.

The President's Committee on Equal Employment Opportunity pointed out to NASA on Oct. 24, several days after the award was made, that a partner in the winning firm, Martin Gurtler, is allegedly an extreme racist. The committee is headed by Vice President Johnson, who is chairman of the National Aeronautics and Space Council.

A subcontractor on all losing bidding teams was Lloyd Ritner, who took a moderate stand as chairman of the New Orleans Parish School Board last year when school segregation was at issue. After the award, the President's committee received a copy of a letter purportedly written by Gurtler to Ritner which contained a harsh denunciation of Ritner's views on school desegregation.

NASA headquarters admitted that it did not know of Gurtler's reputation when the contract was awarded by its Marshall Space Flight Center, but would not withdraw the award because it has found no evidence of discrimination in the company's operations.

Gurtler's bid of $666,417 (AW Oct. 23, p. 27) was accepted as being the lowest fixed fee considered best qualified to do the job. Since the project is on a cost-plus contract, the fee is considered the major financial factor by NASA.

The agency said Gurtler-Hebert was one of four companies recommended by the Army Corps of Engineers. The companies were evaluated on experience, familiarity with the Michoud facility, company organization, manpower and financial soundness. After the four contractors were briefed on the job, two additional contractors from New Orleans entered the competition.

News Digest

Vickers Vigilante anti-tank missile will be ordered into production for the British army. Final contract negotiations are now being completed between the British Aircraft Corp. and the Ministry of Supply. Vigilante will also be evaluated by U.S. Marine Corps next spring.

Lockheed Aircraft Corp. Board Chairman Courtlandt S. Gross announced that Grand Central Rocket Co., Redlands, Calif., has been renamed the Lockheed Propulsion Co. Lockheed acquired complete ownership of the solid propellant manufacturing firm last Aug. 31.

Joseph H. Tippets, director of Federal Aviation Agency's aviation facilities service, has been named assistant administrator for FAA's western region, with headquarters in Los Angeles. Walter P. Platt, now regional manager, will be reassigned in the western region. Donald S. King, chief of the systems staff division, has been named acting director of the facilities service.

Sikorsky S-61L twin-turbine transport helicopter was certificated last week for passenger service by Federal Aviation Agency. Los Angeles Airways and Chicago Helicopter Airways each have ordered four S-61Ls; Los Angeles Airways will take delivery of its first one next week and plans to begin service with it next month.

Air Force will not attempt another Project West Ford launch using backup payload until it is absolutely certain that the initial attempt made from Midas IV satellite has not been successful. As of late last week scientists still had not been able to detect any of the tiny dipoles and were closely examining telemetry data to determine if package had been ejected from Midas satellite. If ejection took place, it is possible that evaporation, intended to release individual dipoles in orbit, is occurring more slowly than expected.

Hughes Tool Co. has asked CAB to approve its plan to buy Atlas Corp.'s 56% controlling interest in Northeast Airlines. Hughes said in a letter to the Board last week, that it was prepared to ensure the financial integrity of Northeast if it is allowed to buy the stock. Meanwhile Northeast has asked Hughes for "emergency" funds to continue operations pending CAB approval of the deal. Hughes also agreed to underwrite Northeast's fuel and oil cost after Oct. 20 subject to cancellation after four days notice.

Boyd Says Fare Increases No Cure-All

CAB chairman calls for other solutions as airlines request variety of boosts, reductions in tariffs.

By Robert H. Cook

Washington—Civil Aeronautics Board Chairman Alan S. Boyd last week publicly denounced the philosophy of considering fare increases a cure-all for the airline industry's financial ills. Meanwhile, one carrier asked the Board for new increases and two asked for a new type of reduced coach fare.

United Air Lines filed for an increase of $1 for first-class jet fares, a raise in first-class piston plane fares to those of present jet fares, and an increase in all coach fares of 5% plus $1. National Airlines had filed earlier for an increase in coach fares from 75% of first-class fares to 85%. The United increase would become effective next Jan. 1 and the National increase on Dec. 15 if the Board approves.

Continental Airlines last week filed for a "no frills" economy coach fare which would be approximately 25% lower than present jet coach fares over a majority of its route system. Designed to "generate enough new air travel to increase the industry's profits," the fare reduction would go into effect on Dec. 1. It would cut the cost of flying from Los Angeles to Chicago, for example, from $102 to $77. To provide the new service Continental would use a new modular design seat with a 32-in. pitch. The carrier's Boeing 707 turbojets would be revised to hold 75 jet economy seats, 36 regular club coach seats and 28 first-class seats. They now have 44 first-class and 76 coach seats. Prepackaged meals would be sold to economy coach class passengers.

American Airlines later matched the Continental filing with a competitive fare to protect its Chicago-Los Angeles and El Paso-Los Angeles markets. It would become effective on the same date. The major difference between the competing services is that American's coach seats will have a 34-in. pitch.

Industry sources speculated that other requests for fare increases and reductions might be added to those filed by late last week.

Consensus of industry opinion has been that the Board would approve modest fare increases, since Boyd has ordered all airlines to report their statistical experience with a variety of promotional fares, along with comments on which ones should be abandoned. CAB already has permitted 8 out of 18 airlines to drop the controversial youth fare plan (AW Oct. 30, p. 41.) Industry comments on the balance of their promotional fares were due by Nov. 3.

But this industry optimism received a sharp setback last week as Boyd sharply criticized the idea of fare increases in a speech before an air transportation symposium sponsored by the Connecticut General Life Insurance Co., at Hartford, Conn.

Posing the problem of what government can do to improve sagging airline profits, Boyd said the Board will insist on other measures to reduce overall industry expenses before it approves fare increases.

"While I do not hold with those who say that the market for air travel is limitless and needs only slightly more than a light tap," Boyd said, "I shudder at any suggestion that the airlines have already corralled all the people who will travel by air. To sit down and simply figure out on the basis of present traffic volume how much of a fare increase is needed to cover expenses and a reasonable profit is, to me, an exercise in futility and sure death, and not a merciful death at that.

Volume Business

"I would say this even if I were certain that the present volume of traffic would keep up at higher rates, and I am far from certain of that," Boyd said. "No one will tolerate a public service industry which runs planes half filled with captive passengers. The industry is all geared up and publicly committed to volume business, and price increases would be a novel means, indeed, of attracting volume. While some fare adjustments, particularly in light of allegations that promotional fares have been uneconomical, would perhaps improve the situation a little, I seriously doubt if the solid answer lies there."

Among the alternatives which Boyd said he favors are such measures as pooling agreements to reduce operational costs, route suspensions or transfers and mergers.

"Pride in individual ownership is fine, but it can be unnecessarily and unwisely expensive to the detriment of the airlines and the paying public," he said with regard to pooling. "I hope that the carriers will re-examine this matter and come up with some money-saving proposals."

Boyd said that while route suspensions would be more likely in the subsidized local service industry, the Board has the authority to apply this to trunk operations and might do so in cases where it is convinced that competition is excessive and the airline has failed to take any action to offset losses arising from duplicative service. He added that the Board is "on the track of a few cases of this kind, but not many."

Possibility of Mergers

Mergers, Boyd said, "probably present the best solution to the problem which the airlines express as basic; that is, excessive competition."

Warning that financial conditions may grow worse, making it more difficult for airlines to receive a fair price for merging with other carriers, Boyd said that if the carriers do not act soon in their own interests, CAB should develop its own merger criteria to spell out which carriers should merge and should produce a report that would "disclose the merger situation in full."

"Where we do not have the power to rectify an undesirable situation in air transportation, at least we can expose it and recommend corrective action," Boyd said.

Competition—which Boyd said had grown as a result of airlines demanding "more route miles, more airplanes, more markets" in search of the "pot of gold . . . seen at the end of the runway"—should be arranged to "strike a balance between benefits and costs."

Competition should be tailored more to its intensity and effectiveness than to the actual number of competitors, Boyd said. He expressed a personal opinion that the best competitive balance between airlines would be realized by having only two carriers on routes between "fairly large cities." In some exceptional cases, he said, monopoly control by one carrier could be justified, and "beyond a certain high density of traffic" there might "occasionally" be justification for three or more carriers on one route.

White House Enters Airline Labor Disputes; ALPA Leaders Are Split

Washington—Complexity of the airline industry's labor problems reached new proportions last week as the White House ordered investigations of two strikes, a presidential emergency board was appointed to avert a threatened walkout on a third, and an inter-union battle flared between top executives of the Air Line Pilots Assn.

The White House asked the three-member Feinsinger Commission to investigate the 18-month strike of ALPA members at Southern Airways and the refusal of Western Air Lines to rehire union flight engineers after a nationwide strike last February.

The commission recently made recommendations aimed at settling the cockpit jurisdiction dispute which led to the February shutdown of seven major airlines by the Flight Engineers International Assn. Western was the only struck carrier which refused to rehire the engineers pending completion of the commission's studies. There have been no ALPA-Southern negotiations for over a year and the airline has been operating with non-union pilots.

The commission's life has been extended indefinitely, since it has been asked to follow through on its pilot-engineer recommendations in addition to investigating the Southern and Western disputes.

Appointment of the Emergency Board was made to avert a threatened strike by Trans World Airlines pilots, scheduled for last Thursday. Issues are the union's impatience with the length of negotiations—14 months—and disagreement over the Feinsinger Commission recommendation calling for three-man flight crews on all turbojets.

Sayen's Announcement

Deeply involved in all of these disputes was the announcement by ALPA President Clarence L. Sayen that he wants to resign in the near future "but no later than the next Board of Directors meeting" scheduled for November, 1962.

Sayen's announcement was made at a public press conference attended unexpectedly by three members of the union's Master Executive Committee, Capt. John Carroll of TWA, first vice president of the union, Capt. Paul Atkins of American, secretary, and Capt. Al Clay of TWA, regional vice president.

Carroll, often mentioned in industry circles as a successor to Sayen, said the resignation announcement came as a surprise since none of the executive committee members had been notified of Sayen's intentions. He questioned Sayen's motives in calling the press conference.

Less than three months ago, an estimated 4,000 ALPA members who have been dissatisfied with Sayen's failure to settle the Southern strike took initial action to force a special meeting of the union's 300-member board to consider action against the airline.

Sufficient signatures have been gathered to call the meeting (AW Aug. 28, p. 38), but the action has not yet been taken. It was indicated that Sayen might be censured for other actions, including a visit to Russia as president of the International Federation of Air Line Pilots. In addition, many ALPA members contend that Sayen has failed to give proper consideration to the master executive committee and the various councils reflecting the thinking of rank and file members.

In a six-page letter to the union's Board, in which he traced the progress made by the union since his election as president in 1951, Sayen said his resignation was based on "purely personal considerations" and had no bearing on matters "within or outside" the union. The early announcement was made to permit an orderly transfer of authority to his successor, Sayen said.

He noted that the union's first vice president would assume the duties of president in the event of a resignation before a new election could be called, but offered no opinions as to a successor. He has considered retiring for five years, and ran for re-election last year "only because I didn't feel they had the right candidate," Sayen said. His opponent was James M. Landis, then a special transportation adviser to the White House.

He said he was aware he had received much criticism from ALPA members, but that he was "not much of a politician" and spent a majority of time working on special projects involving safety and engineering matters.

Most industry observers are openly skeptical over the purpose of Sayen's resignation move, and speculate that it is a purely political maneuver designed to bring about a vote of confidence from his supporters and force a showdown with anti-Sayen factions. As an example, they point out that the press conference came the day after the executive order for an investigation of the Southern Airways strike. Sayen has stated on several occasions his desire for White House intervention.

ALPA policy on reducing monthly flight times appears to be the other large issue dividing the union. Sayen has noted that this is a key part of ALPA talks with both TWA and Pan American World Airways, but he maintains that any reduction should be made in the form of "duty rigs"—more liberal flight time credit for time on non-flight duties. ALPA official stand has never included any reduction of the union's contracted flight time limitations of 85 hr. per month, he emphasized.

However, Carroll implied that an actual reduction of monthly flight times is a major issue at both carriers. He noted that "20 hours a week" was too much flight time in jet aircraft, which have "concentrated the pilot's problems" and added that reducing the flight times "must be done." His opinion was shared by Capt. Clay, who said that the direct reduction had not been tried before because the original duty rigs agreements made during predominantly piston engine aircraft operations seemed logical then.

Crew Reduction

Reduction of flight time was suggested initially by the FEIA in discussions with the Feinsinger Commission. The engineers claimed this would permit reducing four-man turbojet crews to a three-man operation, without endangering the jobs of either ALPA or FEIA members.

Neither the original Feinsinger report issued in May nor the final recommendations mentioned this manner of settling the crew complement issue. FEIA has made no official comment on the final recommendations, but is expected to pursue flight time reduction in contract negotiations with individual airlines.

Both unions have open contracts with TWA and Pan American, and TWA pilots have been reported to favor the flight time reduction method of settling their disputes.

FEIA's reluctance to comment on the final report has raised speculation that the union intends to reject the findings and may seek other means to settle its contract disputes with the airlines.

Verification of this speculation came late last week when spokesmen of the National Mediation Board said the Board will hold a special meeting Nov. 6 with FEIA and management personnel of seven airlines.

It was understood that the subject for discussion would be the Feinsinger report.

The union verified the meeting with NMB but declined to comment on what course of action would be followed.

On the basis of FEIA statements issued after its February strike, it is now believed FEIA may be prepared to demand industry-wide bargaining on its contracts.

Sage Computers Called 'Useless' For Terminal Area Traffic Control

Miami—Federal Aviation Agency Administrator Najeeb E. Halaby charged last week that Sage system intercept computers are "absolutely useless" in the control of air traffic moving through a terminal area—the area in which "the greatest need for an improved system" now exists.

"A discriminating, limited and practical use" of Sage computers may prove possible in the northwestern or north central U. S. where Sage sites are relatively concentrated in relation to air traffic flow, Halaby said. But in the New York area, Sage facilities are "hopelessly inadequate" as a means of controlling en route civil and military aircraft flying under instrument flight rules, he contended.

Speaking at a press conference here, Halaby also said that the Sage air defense computers displayed data in an unsuitable manner for air traffic control purposes. Because of the demand imposed on the computers by Sage itself, many had little left-over capacity for ATC. Those that do often are in the wrong location, Halaby said.

Whether the Sage computer can play a prominent role in the ATC system of the future is a question that Department of Defense and FAA so far have been unable to resolve. FAA's refusal to assume fiscal responsibility for maintaining the entire Sage network, an annual cost of $300 to $500 million or about half of FAA's current budget, has delayed the release of the Project Beacon report by about four months now. Project Beacon task force was appointed by Halaby to define ATC goals during the next decade.

Before impugning the Sage computer's usefulness as a primary ATC tool, Halaby admitted that FAA research and development funds for "the last few years" have not been "well managed." The ATC system has been improved more by "accretion" than development, he said.

Air Force and industry engineers here for the Air Traffic Control Assn.'s annual conference expressed the opinion that FAA and DOD should compromise the issue. FAA, these sources maintained, could exploit the experience of Sage-trained technicians if it agreed to utilize Sage computers in areas uncongested by heavy air traffic. Concurrently, FAA would be free to evaluate or install more specialized civil systems at major terminals or along heavily-traveled airways.

The prepared text of Halaby's speech to ATCA's conference contained this section: "I think it is obvious that if this problem area [use of Sage], which is an extremely complex one, is not resolved by DOD and FAA soon, the decision regarding future control systems will be made at the presidential level." However, he omitted these words when he spoke.

About 90% of the Beacon report, measured in pages, has been agreed to by the Pentagon, Halaby said. Pending a full accord, Halaby announced that he has set up a "system design team" in Washington to "ensure a smooth, revolutionary transition from today's ATC environment to a modernized airspace system" (see p. 29). To push ahead with the noncontroversial aspects of Beacon, this team will evaluate "the best available talents, management tools, and other resources within and outside the agency," Halaby told the convention.

Concurrently, Halaby said, a counterpart team called FAA's air traffic service operations group and composed of agency experts will supply the system design team with operational requirements of the ATC system ultimately selected.

On other subjects, Halaby reported:

- **Federal Aviation Service,** the new service charged with manning both civil and military ATC facilities during war and peace, would encompass about 28,000 personnel. Off these, 17,000 would be air traffic control specialists; 9,000 electronics and maintenance specialists.
- **Those in FAA** who refused to join FAS, if asked to do so, would not lose their jobs. These employes, however, "may be reassigned to less critical positions or places," Halaby said, and acceptance of FAS membership may be made a condition of FAA employment.
- **FAA is considering** a program under which selected air traffic controllers would be given flight training to familiarize them with the operational characteristics of modern aircraft. Another program aimed at raising morale and motivation among controllers is now under study and would involve cash bonuses for outstanding achievement.

Traffic Session Officers

Washington—William L. Morrisette, Jr., vice president-sales and advertising for Eastern Air Lines, has been elected president of Air Transport Assn.'s Air Traffic Conference of America.

C. Gordon Brown, vice president-traffic and sales for Piedmont Airlines, was elected first vice president of the conference and T. M. Miller, vice president-traffic and sales for Delta Air Lines was elected second vice president.

The conference met late last month in semi-annual session to develop ways to improve air transportation from the point of view of the passenger, shipper and postal user.

Seaboard-Lufthansa Pact Draws Protests

Washington—Pan American Airways and Trans World Airlines have protested an agreement that would allow Lufthansa to buy cargo space on Seaboard World Airlines' New York-Frankfurt cargo flights for a flat fee regardless of the portion used.

Terms of the agreement call for Lufthansa to buy 20,000-lb. of cargo capacity on six round-trip CL-44 cargo flights weekly between New York and Frankfurt for $4,300 each way whether any part or all of the space is used. Lufthansa would pay 21.5 cents per ton mile if it needed capacity above 20,000 lb. and Seaboard was willing to provide it.

Lufthansa would also pay Seaboard $100 for loading and unloading the aircraft and be responsible for clearance and documentation of its own cargo. Seaboard would allow Lufthansa to paint its name and colors on one side of two of its CL-44s.

Pan American and TWA object to the agreement on grounds that it will hurt their competitive New York-Frankfurt cargo service with capacity involving "a substantial part" of an American carrier. Pan American conceded that Civil Aeronautics Board has approved similar agreements in the past, but only in connection with starting services under special circumstances. TWA fears that with six round trips weekly "underwritten" by Lufthansa, Seaboard would be in a position to divert a considerable part of its Frankfurt-bound cargo.

Seaboard noted that neither TWA nor Pan American gave any figures to support their claims of diversion. Seaboard said that the agreement would strengthen its position with greater equipment utilization. Agreement is set to begin Dec. 1 for 13 months.

CJ805-23 TBO Rate

Federal Aviation Agency has approved initial time between overhauls (TBO) of 1,200 hr. for General Electric Co.'s CJ805-23 aft-fan engine. Hot section sampling will not be required, but a five-engine overhaul sample will be taken at 1,000 hr. Aft-fan powerplants are scheduled for Convair 990s ordered by American Airlines.

Britain, France Team on Mach 2.2 Transport

London—British and French aircraft firms will team to develop a Mach 2 plus transport with a 1970 operational target date as a result of top-level governmental negotiations now being concluded between the two countries.

The Anglo-French consortium will utilize British Aircraft Corp., which now has a British government supersonic transport study contract, and Sud Aviation, which has been designing a supersonic Caravelle (AW June 5, p. 40).

Although the official inter-governmental agreement has not been concluded, BAC and Sud are already laying the foundation for technical co-operation with subcontracts for BAC's VC.10 and Model 111 jet transport components being negotiated with Sud. Present Anglo-French planning aims at a seating capacity of about 100 with a Mach 2.2 top speed and built in two basic versions, one for the transatlantic route and another to do both the U.S. transcontinental run and the basic British and French Eastern routes such as London-Cairo and Paris-Istanbul.

It is likely that Dr. A. E. Russell, chief designer of Bristol Aircraft before its merger with BAC, will direct the joint program.

Requests Due Soon for Research Plans on Supersonic Transport

Washington—Requests for detailed research proposals that will produce the preliminary design for a U. S. supersonic transport are scheduled to go out to industry before the end of this month. These proposals will form the basis for the awarding of $11 million in research and development contracts, beginning in January.

The research and development work will run from one to two years but is expected to produce enough technical knowledge to provide the first working design of a supersonic transport by the end of next year. The development program is being conducted jointly by the Federal Aviation Agency, National Aeronautics and Space Administration and the Defense Department.

FAA estimates that airframe design proposals could be expected within 12 to 18 months from the beginning of the research contracts, and powerplant design proposals after two years of engine study and test work. Completion of these design phases could produce a prototype transport by 1966 and type certification by 1970, joint studies by the three agencies indicate.

Early selection of an engine capable of meeting a wide range of thrust requirements is considered critical to the development timetable and will claim a major portion of the research and development funds allotted for Fiscal 1962. Total research requirements for both airframe and powerplant studies in Fiscal 1963 have been estimated at $40 million to $56 million.

Details of the research proposal requests, on the basis of current knowledge of supersonic transport design problems, can be expected to follow these lines:

- **Current contracts** on a study of new types of supersonic transport powerplants continued and expanded into Fiscal 1962. The U. S. Air Force now has contracts with both the General Electric Corp. and Pratt & Whitney Aircraft Division of United Aircraft Corp. to explore the efficiency and practicality of several turbine engine variations. Under study are such new engine types as the turboramjet, turbofanjet and turbofan-ramjet.
- **Extensive component** testing program to evaluate the new designs. This would include the model testing of advanced compressor designs, along with new types of combustors designed to burn either new or conventional fuels.
- **Research** into the problems of controlling airflow in and out of engines.
- **Studies** on the use of duct heating and power augmentation for use with the high-bypass-ratio ducted fan engine, which FAA considers one of the most promising types yet studied.

NASA and USAF both have research programs which can be used to augment industry studies in these areas, and are also involved in fuel research and engine control programs for supersonic aircraft.

Wide Spectrum

Airframe research programs would cover a wide spectrum of problems involving aerodynamic design, structures and materials, stress loading and airframe systems.

Priority in this area will probably be given research on materials, since the supersonic transport is planned to have a life of 30,000 to 50,000 hr. and there is now no reliable method to determine what effect this amount of exposure at high temperatures will have on the aircraft's construction.

On this basis, airframe research would be concentrated in these areas:

- **Study of stainless steel** and titanium alloys to select the metal capable of meeting the problems of long life, fatigue, crack propagation and fabrication.
- **Research and testing** to correlate design details and structural strength details for variable geometry wing pivots.
- **Study of high lift** devices necessary to permit supersonic transport operations on current runway lengths. This would include means of improving high lift capabilities of fixed wing configurations, adaptation of devices to variable sweep wing configurations, and their application to emergency landings where variable sweep aircraft have wings retracted or fixed wing aircraft have flaps undeflected.
- **Explore methods** of flutter prediction through the designed speed range.
- **Studies of landing** descent rates and loads in order to arrive at desirable piloting techniques for landing speeds and loads.
- **Research into methods** of averting loss of cabin pressurization during high altitude operations and developing new auxiliary power systems capable of withstanding the expected operating temperatures of 600 to 650F.

Panair Sees Need For 3 Super Caravelles

Paris—Panair do Brasil has indicated in a letter to Sud Aviation that it may want to purchase three aircraft like the medium-range Super Caravelle supersonic transport by 1967-68.

Panair's intention was outlined in a letter attached to the Brazilian carrier's firm order for four subsonic Caravelles (AW Oct. 23, p. 33). The letter stated that Panair's routes would require three such supersonic aircraft by 1967-68, target date for initial Super-Caravelle deliveries.

The letter in effect gives Super Caravelle delivery priority to Panair over all future buyers with the exception of Air France.

Legal status of the Sud-Panair letter is uncertain. The document is not a legal letter of intent but it does indicate serious interest in the Super Caravelle by Panair and implies its desire to order in specific quantities.

Recently the French government firmed up the design by backing Sud Aviation's configuration rather than the one proposed by Avions Dassault. Sud's configuration, disclosed in model form during the Paris air show last June (AW June 5, p. 40), centers on a double-delta wing form with wedge-type engine intakes slung under the wing trailing edge.

Dassault's version utilized a canard-type layout with engines buried as they are in Dassault's Mirage IV bomber. Dassault will continue to work closely with Sud on the Super Caravelle.

Short-Range Jet Transport Needs Studied

By William H. Gregory

New York—Eastern Air Lines has sketched a generalized specification of a short-range jet transport to replace the Convair 440 or Martin 4-0-4 class airplane, but also is taking a serious look at rotary-wing aircraft for the same or complementary application.

Only one jet aircraft in the short-range class is committed to production—the British BAC 111 which Braniff Airways ordered last month.

Of the trunklines—outside of Braniff—Eastern has shown the strongest interest in a short-haul jet. American also is looking, and there also is interest, though far from unanimous, on the part of American in rotary wing aircraft.

Eastern invited top officials of local service carriers to its staff meeting in Miami last month to hear its staff debate requirements for a short-haul jet, hoping to stimulate discussion by others in this area. Carriers attending were Allegheny, Central, Lake Central, Mackey, Mohawk, North Central, Ozark, Piedmont and Southern.

U. S. Studies

Eastern also appears to be prodding U. S. manufacturers who have design studies of the short-range class (AW July 10, p. 41). Their status:

- **Boeing 737.** Boeing has briefed various airlines on this family, one powered with a 7,500-lb.-thrust version of the Pratt & Whitney JT8D turbofan engine in the Boeing 727. Boeing's Vertol division has talked to airlines in terms of its V 107 twin-turbine helicopter. With its heavy commitment in the 727 program and its awareness of the major problem in achieving a truly economic short-haul jet, Boeing is hoping no firm specification will be laid down for this category for a year or two.
- **Douglas** with its Model 2086 family is reported to have approached airline thinking closely. Douglas engineering urged going ahead on the project several months ago, but top management turned down the plan because of Sud Caravelle interests and commitments of company funds for the DC-8F Trader cargo plane program. The 2086 is thus not currently active.
- **General Dynamics** has proposals in the light jet class, but current absorption in problems of its Convair 990 make any new commercial effort doubtful.
- **Lockheed** also has done studies in the small jet field, but airlines feel this company's interests are more concerned with a supersonic transport.
- **McDonnell Aircraft** has discussed its T85A twin jet proposal with various airlines, but has not been encouraged with results of its market surveys.
- **North American Aviation** proposed a four-engine aircraft powered by the General Electric CF700 turbofan engine in the 4,000-lb.-thrust class. Airline preference for a twin-engine configuration has led to a twin-engine proposal.
- **Sikorsky Aircraft** has discussed rotary-wing configurations grouped under the designation S-65 with Eastern, American, and Trans World Airlines (AW Oct. 2, p. 47). This concept, on the order of the S-64 turbine crane in size, would carry 60 passengers at a speed of 150 kt.

At stages below 100 mi., costs of the S-65 would be lower than Eastern's current twin-piston equipment, perhaps half as much on certain routes such as Washington-Baltimore. Eastern's Engineering Vice President, Charles V. Froesch, told the group.

STOL aircraft also could fill local service requirements, but in terms of 1965 operation, only helicopters and short-range turbine airplanes are likely to be available, Froesch said. No one aircraft appears likely to fill all short-haul requirements by 1965, and thus Froesch believes a mixed fleet of helicopters and fixed-wing aircraft may be the solution.

For some carriers, the Caravelle, with a gross weight in the 100,000-lb. category, or the Boeing 727, with gross weight of 142,000 lb., may be utilized for the very short hauls on the theory it would be less costly to operate them uneconomically at times rather than buy a new type of airplane.

National Airlines still is interested in trading in its Electras for Caravelles (AW Oct. 3, 1960, p. 39), but a near term order is unlikely. Delta Air Lines is a possible General Electric-powered Caravelle customer, and so are Continental and Western Air Lines, though Continental has also expressed interest in the BAC 111.

Most probable immediate orders for the GE Caravelle, however, are from two foreign carriers—Air France and Japan Air Lines.

The twin-turbofan airplane envisioned by Eastern has gone through some scaling down since the staff meeting. At that time it would have had a maximum gross weight of 69,700 lb., a 14,000 lb. payload, and carried 48-52 passengers in first-class configuration. Now Eastern is thinking in terms of 65,000 lb. gross and 44-48 passengers.

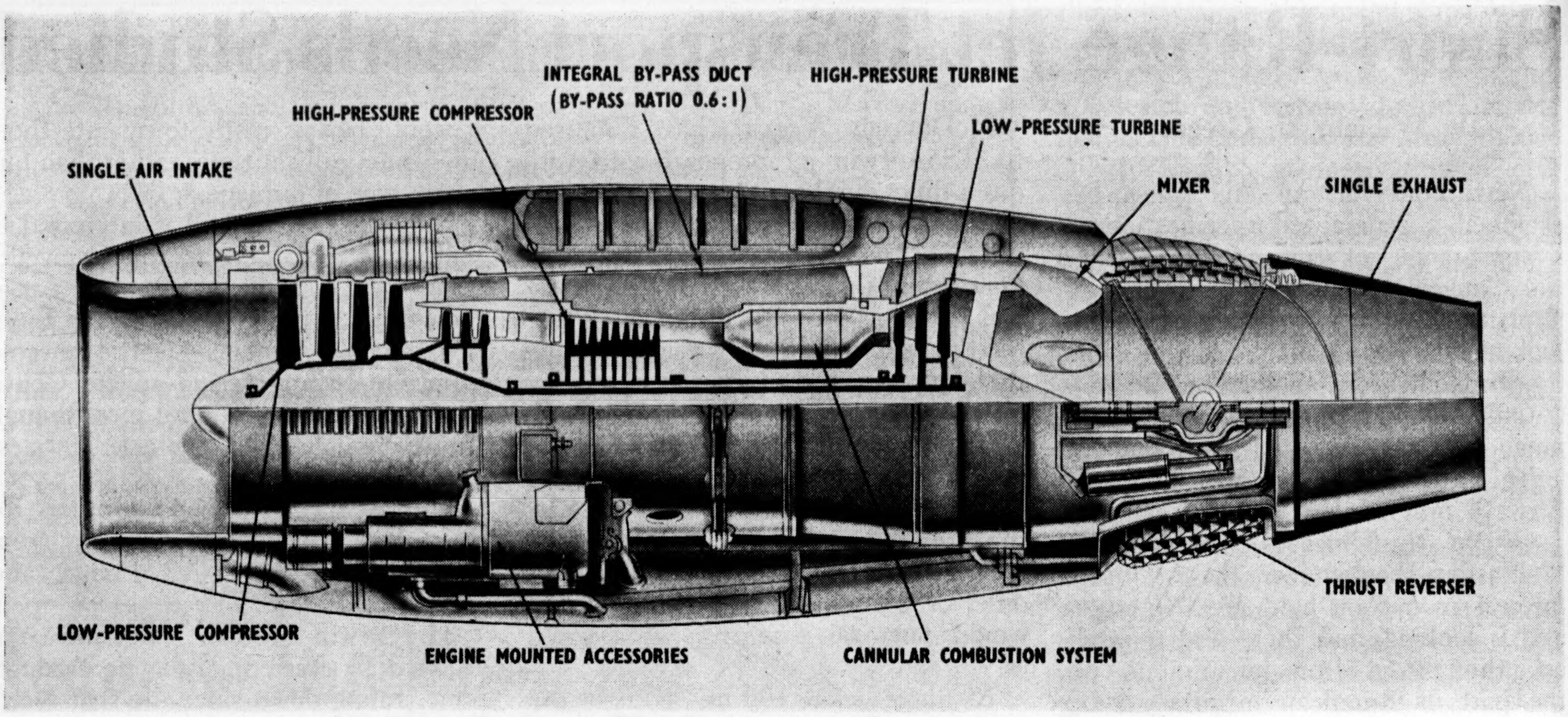
Powerplants, to be rear-mounted on the fuselage in Caravelle fashion, would be Pratt & Whitney JTF10-7 turbofans rated at 10,500 lb. thrust. Navy support for the engine reportedly calls for $8 million in the current fiscal year.

In order of importance, Eastern listed requirements as:

- **Adequate payload,** specified at 13,000 lb. in latest studies.
- **Best low speed** performance available. Swept wings are acceptable, but not leading edge devices. Trailing edge flaps no more complex than double slotted Fowler type are specified, but a

BRANIFF International AIRWAYS

MODEL OF TWIN-JET BAC 111, which will be built by a British Aircraft Corp. Group, shows how the airplane will look in Braniff International Airways' markings. Braniff has ordered six BAC 111s, and has an option on six more (AW Oct. 23, p. 45).



Rolls R.Co. 42 Conway Turbojet Detailed

Cutaway drawing of Rolls-Royce R.Co. 42 Conway turbojet engine which will power the Vickers VC.10 four-jet transport shows details of bypass duct and thrust reversers. Bypass ratio is double that of the R.Co. 12s powering Boeing and Douglas jet transports—0.6:1 against 0.3:1—for a higher mass flow and improved specific fuel consumption. High-pressure section, including high-pressure compressor and turbine and combustion equipment, is identical with earlier Conway engines. Nine-stage high-pressure compressor is driven by a single-stage high-pressure turbine; four-stage low-pressure compressor and three-stage intermediate compressor are carried on a common shaft which is driven by a two-stage low pressure turbine. Thrust reversers are of clamshell door type developed by Rolls; doors are along inner wall of jet pipes in flight and thrust is reversed when doors swing rearward, closing the jet pipe and deflecting exhaust gases through cascades in reverse jet apertures. Conway 42 has been running on test stand since March.

simple boundary layer control system (blown flap) would be permitted.

- **Short field performance.** Earlier requirements called for operation into and out of 4,500 ft. fields on a 90F day for a 300 mi. flight against a 30 mph. headwind with a 2-hr. fuel reserve. For the lighter airplane, Eastern would prefer 4,200 ft. field lengths.
- **Low initial cost** and low operating and maintenance costs.
- **Self-contained** systems for starting and other ground requirements.
- **Highest possible cruise speed,** specified as 500 mph., ±30 mph.

One consideration of size is to prevent the airplane from requiring a third crewman, which would substantially increase operating costs. Use of the JT8D-1 turbofan engine from the Boeing 727 was studied, but this resulted in an aircraft of 75,000-80,000 lb. gross weight and capacity of 54-79 passengers. Not only would this require a third crewman, but its cabin capacity would be excessively large for local schedule operation, ruling it out of consideration for local service carrier and corporate operation.

Systems and components must be unsophisticated and reliable. As an additional economic and environmental requirement, an airborne auxiliary power unit is specified. It must be capable of providing all normal in-flight electrical needs in addition to ground starting and air conditioning. This power unit must be designed to permit dispatch with one engine-driven generator or hydraulic pump inoperative.

Use of engine bleed air for pressurization, air cycle cooling and anti-icing is indicated. Since the twin-engine airplane would have only two engine accessory drive pads and the APU, it would of necessity be more a pneumatic than an electrical airplane, Eastern notes.

Dependence on engine bleed air for anti-icing points out the importance of engine size. In the Electra, Eastern experience shows, full anti-icing means a power loss equal to full cruise power of one of the airplane's four Allison 501D13 engines, and a proportionate loss on a twin-engine airplane would be more critical.

Either a single front or mid-cabin left side passenger door with integral stair is acceptable. Interior cabin dimensions call for minimum headroom of 78 in. and maximum width of 118 in., the latter permitting five abreast seating.

Non-boosted flight controls are preferred, and also a stationary horizontal stabilizer.

Cost of the engines is estimated at $185,000 each. Estimates for total airplane costs are $2-$2.3 million depending on fuselage size. The BAC 111 price is $2.4 million. Four fuselage configurations were analyzed: a 118 in. oval fuselage, the width and cross section of the DC-7B; 118 in. circular section; 108 in. oval, and 108 in. circle. The latter width is between that of the Martin 4-0-4 and the Convair 440.

Cost per mile of the 118 in. oval and 108 in. oval fuselage airplanes—the 69,000 lb. version—was estimated alongside actual costs of Eastern's DC-8. They showed:

	118 in.	108 in.	DC-8
Flying operations	$.5261	$.5231	$1.0909
Direct maintenance	.2037	.2017	.4937
Depreciation	.2491	.2462	.5203
Total	.9789	.9710	2.1049

These cost-sections are retained for the 65,000 lb. airplane.

The BAC 111, with performance adapted to the 10,400 lb. thrust estimated in the growth version of its Rolls-Royce powerplant, the RB. 163-2 Spey, was evaluated in some categories alongside the Pratt & Whitney-powered airplanes.

On a 100F day at 68,000 lb. takeoff weight, the field length required by the BAC 111, with 980 sq. ft. of wing area, was 6,930 ft. The 118 in. fuselage, 69,000 lb. airplane would require 6,840, and the 108 in. fuselage airplane 6,340 ft.

Since none of these met the 4,500-ft. field requirement, Eastern proposed that the effect be studied of a 10% increase in wing area on ride comfort, empty weight, drag and field performance. The 1,000-sq.-ft. wing area of the 69,000-lb. airplane is retained for the 65,000-lb. successor, in effect, providing a larger wing.

TAI Dominates Tahiti's Tourist Activities

By L. L. Doty

Papeete, Tahiti—Transports Aeriens Intercontinentaux, a privately-owned French airline, has become so firmly entrenched in the growing Tahitian tourist market during the past two years that any new air services will be severely handicapped in initial competitive efforts.

It is highly likely that any new carrier certificated to serve Tahiti will find it all but impossible to overcome or even match TAI's position there. Not only does the French carrier serve all the major routes feeding into this island but it operates with the blessings of the local French government which imposes rigid restrictions on foreign businesses and investments.

Only U. S. carrier serving Tahiti is South Pacific Air Lines which operates once a week service with a single Lockheed Constellation 1049G on the Honolulu-Papeete run, its only route. TAI competes with South Pacific on this route with a once-weekly Douglas DC-8 turbojet service, and will increase the schedule to twice-weekly next year.

TAI operates the Los Angeles-Tahiti route exclusively. Its only major competitor on the transpacific route west of Tahiti is TEAL, which serves the island route between New Zealand and Tahiti with Lockheed Electras. TAI uses only the DC-8 on all its major Pacific routes.

Strong in Polynesia

TAI's dominance over South Pacific routes is only a part of the strong position it holds in this market, which only recently began to attract serious tourist attention. Throughout French Polynesia, TAI has also established a stronghold that appears to be a firm barrier to foreign competition.

It has developed a closely coordinated program with local hotels, predominantly backed by French capital, and thus is able to provide its clientele with a variety of accommodations. Due mostly to TAI's efforts, these hotels are about to adopt off-season rates, commissions for travel agents and a spread of room prices. Until recently, all rates were high and were the same throughout the year.

Only one U. S.-financed hotel is located on the island and this will probably be the last since the French have ruled that no foreign investment may exceed 50% of the total capital invested in any one project. The balance must be French capital. Because of recent colonial problems, the French are not eager to enter into this type of investment. This means that prospects for increasing the number of hotel rooms beyond the approximately 400 now available are slight, leaving any new airline competition with little margin to expand the tourist trade.

In addition, the French government is discouraging excessive hotel construction and will not permit the building of multi-storied hotels. It is determined to maintain the native character of Tahiti, and, so far, it has been successful. The government and TAI want only a de luxe type of tourist trade.

Free Room and Meals

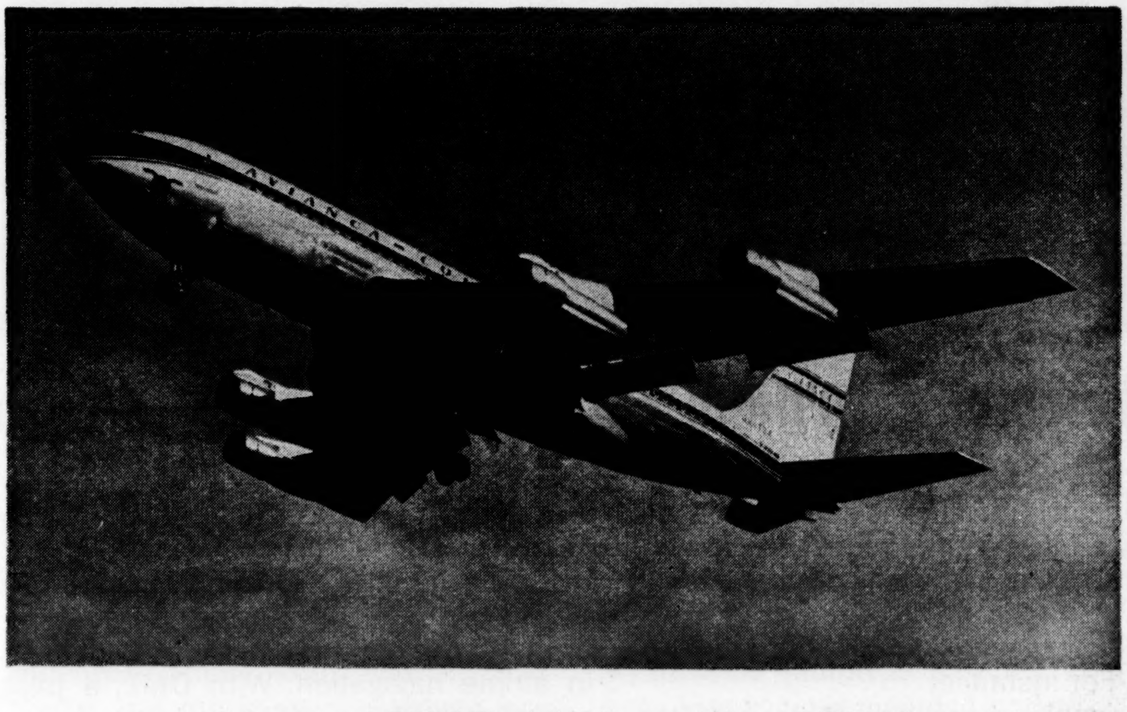
TAI is using its close connections with the hotels here to lure passengers away from transpacific services conducted by Qantas and Pan American. On through flights, it offers passengers a stopover of Papeete en route with TAI paying for the hotel and three meals. In effect, Tahiti is providing TAI with a steady stream of customers flying on long-haul, high revenue, transpacific tickets. It is not restricted to the relatively short-haul Tahiti-and-return service as is South Pacific.

Should foreign competition find means to match this hotel service, TAI has another card to play. TAI controls the local airline, Regie Aerienne Interinsulaire, which operates an inter-island with a Sunderland flying boat. Stopover passengers are offered a free flight from Papeete to Bora Bora during their stopover.

To establish an even tighter grip on the Tahitian tourist trade, TAI, outlined these plans for the future to AVIATION WEEK:

- **It has persuaded** the French government to build runways on several of the outer islands of the Society group, including Rurutu and Rangirda. Bora Bora now has a runway. Sometime next year, when these runways are completed, TAI will operate regular DC-3 service to these islands, offering tourists a greater variety of vacation activities. The flying boat will conduct sightseeing flights to the west over the islands and atolls of the Gambier and Tuamota groups.
- **By mid-1962,** it will be operating six flights weekly into Tahiti from the U. S. mainland and Australia. It has received permission to drop the Los Angeles-Honolulu leg of its route system. This portion of the operation has been unprofitable, according to TAI spokesmen, since it cannot carry local Honolulu-Los Angeles traffic.
- **At the same time,** it will operate a Douglas DC-6B schedule between Tahiti and Noumea via Bora Bora, Wallis Island and Nandi in the Fiji Islands. Presumably designed to compete with TEAL, it will be billed as the French Coral Route.
- **TAI will bring** groups of travel agents and personnel of other airlines in both Europe and the U. S. to Tahiti for brief visits as a means of winning their sales support. Initial plans call for as many as 15 persons a week to take part in this program, according to officials of TAI.

Important to TAI's position in Tahiti is the maintenance and overhaul services it provides at Faaa Airport. The airline provides a complete facility upon



Avianca 720B Makes First Flight

First Boeing 720B turbojet airliner for Avianca of Colombia takes off from Renton, Wash., airport on its first flight. Avianca has two of the aircraft on order from Boeing. They will operate between Bogota, New York and Europe.

At American Airlines we do an awful lot of repeat business

American is usually the choice of people who fly a lot. And it isn't just because of our pretty stewardesses and delicious meals.

The big reason is American's dependability. For instance:

American's great new Astrojet* (the first plane with fan-jet engines) cruises faster than conventional jets, yet doesn't need endless runway space. Its reserve power makes on-time arrivals more certain.

Only American's jet fleet is completely equipped with Distance Measuring Equipment, the most important advance in airline navigation. With DME, a pilot can pinpoint his position instantly.

American's pilots have flown more passengers than any other group of pilots in the world. Many are 7-million-mile men.

Our planes are kept in peak condition by one of the largest maintenance set-ups on earth. At American's Tulsa Base, over 3,000 aircraft experts regularly inspect every part of every plane in our fleet.

Experienced travellers like American's equipment, and they like the way we take care of it.

Next time you fly, go American, the choice of experienced travellers.

AMERICAN AMERICA'S LEADING AIRLINE

* SERVICE MARK OF AMERICAN AIRLINES, INC.

which all carriers operating into Tahiti must rely to some degree.

A major problem to TAI in the development of a tourist trade has been the generally poor reaction of visitors to the island. According to TAI officials here, only two out of 100 tourists—as an average—are enthusiastic on the first visit. However, they found that this ratio increases to 8 out of 10 among visitors who stay for an extended length of time.

Airlines Heed Warning On Electra Hydraulics

Washington—Electra operators are complying with a recent Federal Aviation Agency "alert" to guard against malfunction of the hydraulic boost system on the turboprop aircraft (AW Oct. 23, p. 34).

Detailed orders on how to disengage the system, in the event of a hydraulic power failure during takeoff, have been included in the daily operating manuals on seven major airlines.

FAA's advisory was issued shortly after American Airlines directed its pilots to remove the floorboard covering over the system during all takeoffs and landings. Flight engineers were ordered to stand by to disengage the boost system on takeoff at the captain's command.

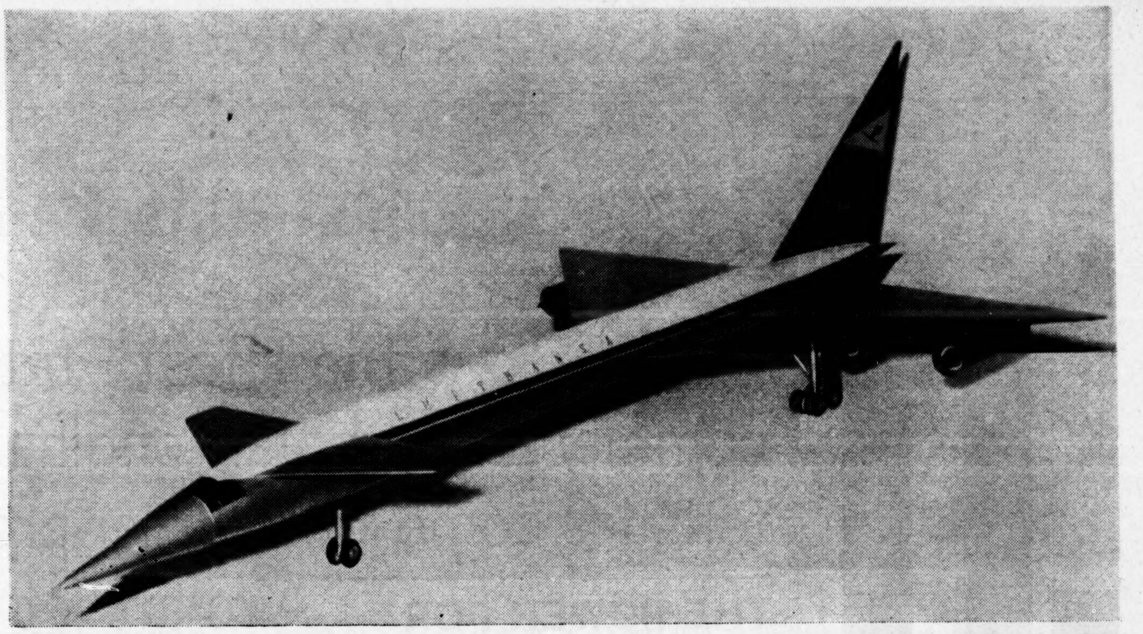
American's order was issued only five days after the crash of a Northwest Airlines Electra at Chicago with a loss of 37 lives on Sept. 17.

During air safety hearings conducted by Congress earlier this year, the Flight Engineers International Assn. charged that location of the boost system control lever created a hazard because it is difficult to reach. The union stated that complete loss of hydraulic pressure in the Electra could result in locked flight control surfaces until the boost controls are disconnected manually.

TWA Reports Loss

New York—Trans World Airlines reports a net loss of $12,733,000 for the first nine months of 1961, compared with a net profit of $6,083,000 during the same months of last year. Net loss for the third quarter of 1961 was $1,009,000 on operating revenues of $106,277,000. In the third quarter of 1960, TWA made a net profit of $6,079,000 on operating revenues of $113,026,000 (see p. 52).

Revenue passenger miles for the nine month period declined 10% while available seat miles increased 4.9%. System passenger load factor was 55.9%, down from 65.1% for the same period of 1960.



PRELIMINARY specifications of the Mach 3 Lufthansa transport cited include: fuselage length between 180 and 196 ft., or about double the span of the aircraft; maximum takeoff weight between 352,000 and 440,000 lb.

Lufthansa Favoring Mach 3 Jets For Transatlantic Replacements

By Edith Walford

Geneva—Deutsche Lufthansa West German Airlines favors a Mach 3 supersonic turbojet design as a future replacement for its present fleet of subsonic jet transports for transatlantic service.

The choice of a Mach 2 to Mach 2.5 aircraft, as is now being planned in Great Britain, would, in Lufthansa's opinion, only fill an intermediate requirement and result in heavy investment in new supersonic equipment when U.S.-proposed Mach 3 versions appear on the scene and are adopted by competitive carriers.

A Lufthansa spokesman said the company does not necessarily intend to fly such aircraft at their maximum speed initially. The plan is to be equipped well in advance for the Mach 3 era, which the company feels is bound to come.

According to Gerhard Holtje, a member of Lufthansa's board of directors, the West German carrier is convinced of the need to concern itself at an early date with all the technical and operational problems which will accompany the introduction of supersonic commercial air traffic when it becomes a reality in about 10 years. To avoid loss of time and development costs, he says, any project under development should incorporate the future users' individual requirements, a major condition for any Lufthansa orders. It is essential, Holtje said, that manufacturers and future users exchange ideas and, in general, work together as closely as possible during design and development of supersonic jet aircraft.

These considerations have led Lufthansa to produce its own model of a Mach 3 aircraft, which it believes will fit its long-range route structure needs by the early 1970s, Holtje said. The model was prepared after careful study of the designs currently under consideration in the U.S., Great Britain and France and a thorough discussion of the project with the aircraft industry.

Preliminary first prototype specifications cited by Lufthansa include:

- **Fuselage length** between 180 to 196 ft., or about double the span of the aircraft. (Length of a Boeing 707 is about 153 ft.; its span 142 ft.) Fuselage of the supersonic Lufthansa version would, therefore, be considerably longer and its span much less than that of current big jet transports.
- **Assuming that the aircraft** can seat between 100 and 150 passengers, maximum takeoff weight would be between 352,000 and 440,000 lb. (Takeoff weight of a Boeing 707 is 316,000 lb.)
- **Proposed Delta wing** of the Lufthansa design would be located near the rear of the fuselage and the elevators in the forward fuselage section. This canard form of construction offers considerable aerodynamic advantages when flying at supersonic speeds, according to Lufthansa's engineers, Holtje said. For example, when trimming, this arrangement increases the lift of the aircraft, whereas it has the opposite effect of decreasing lift and producing additional drag when, as is usual, the elevators are mounted in the tail.
- **Lufthansa prototype** probably would have four engines mounted underneath the wings at the rear of the fuselage, but no decision has yet been reached on whether these will be of the pure jet, ramjet or turbofan type.

JT
8D

THE POWER FOR BOEING'S NEW 727 HAS A BLUE RIBBON ANCESTRY

The JT8D is the latest Pratt & Whitney Aircraft commercial turbofan engine. Many of its characteristics come from other proven Pratt & Whitney Aircraft jet engines.

The JT8D utilizes the same design philosophy and basic technology of the jet engines which have more than 15 million hours of performance and reliability to their credit. Also from these proven engines, the JT8D inherits a sound, sophisticated jet design. And from the JT3D turbofan, which powers the fan versions of the Boeing and Douglas jets, comes the essential design for the fan structure of the JT8D.

American Airlines, Eastern Air Lines, Lufthansa and United Air Lines have all ordered this latest turbofan engine for their new Boeing 727s. Turning out 14,000 pounds of take-off thrust, the JT8D helps make it possible to operate efficiently from runways that used to be too short for modern jet travel. Now additional cities coast-to-coast will be connected to the rest of the world by jet.

PRATT & WHITNEY AIRCRAFT DEPENDABLE ENGINES

U
PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION
A

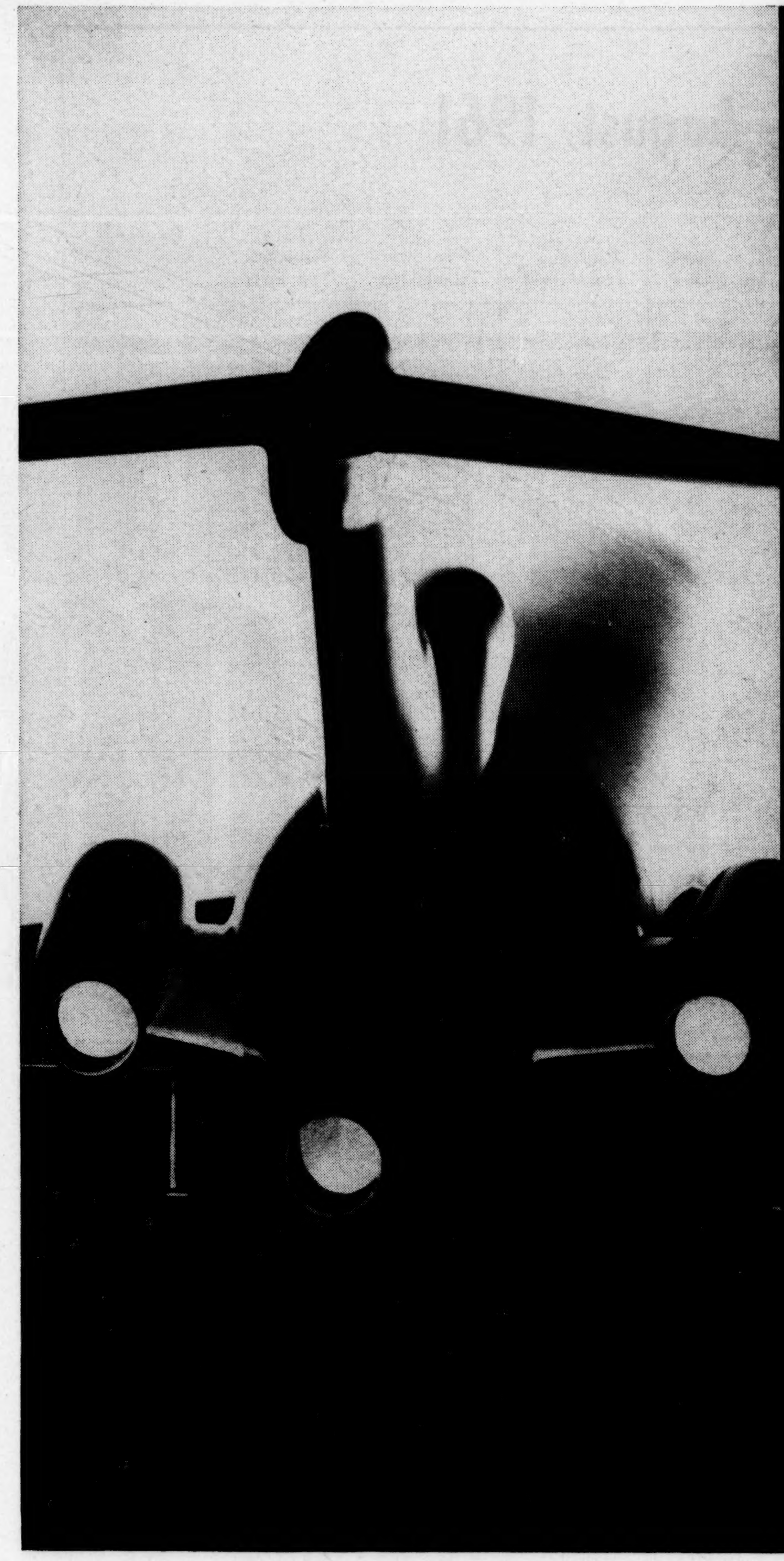
Airline Traffic—August, 1961

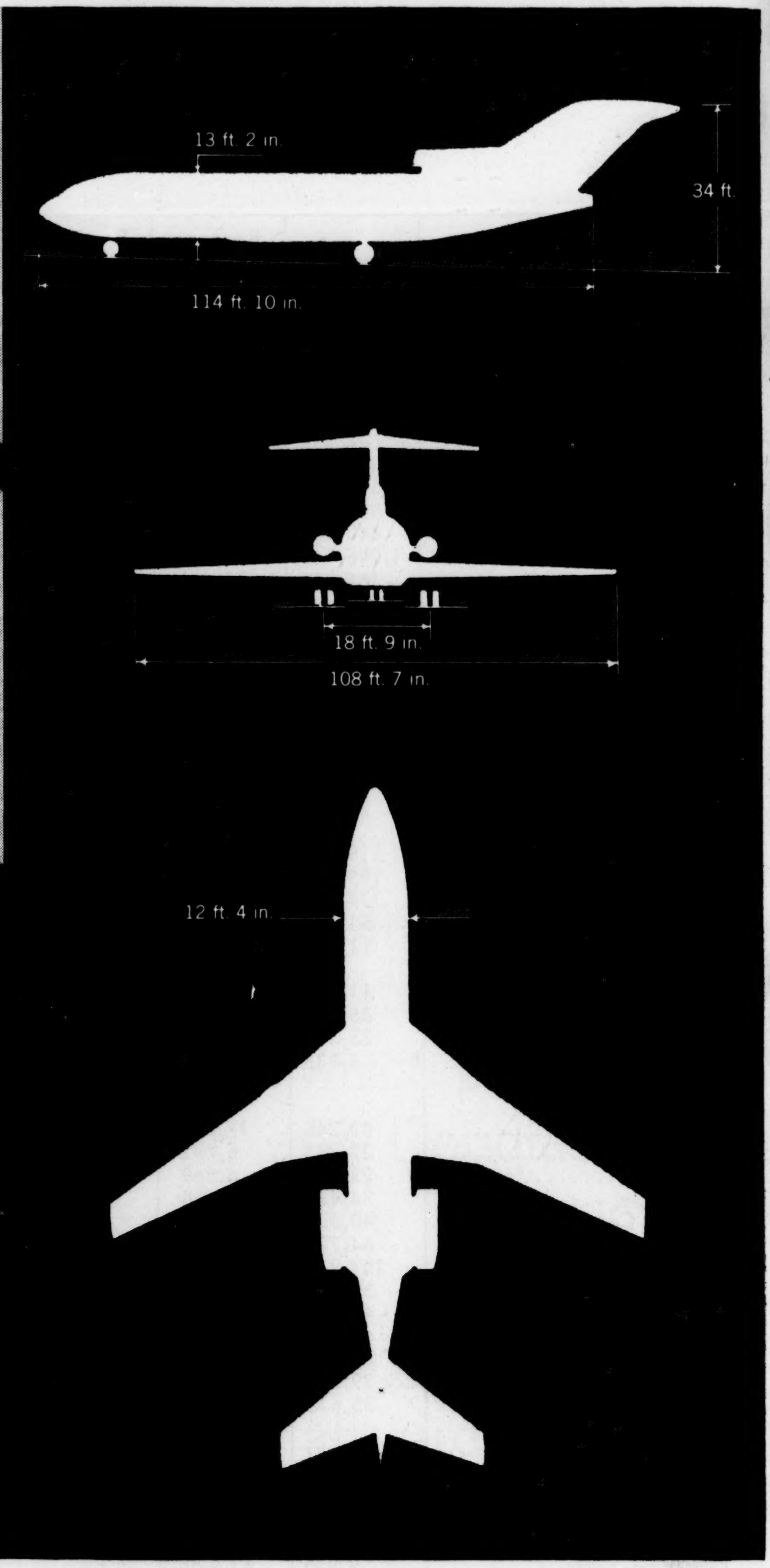
	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton Miles	Express Ton Miles	Freight Ton Miles	Total Revenue Ton Miles	Over-All Load Factor %
DOMESTIC TRUNKS								
American	687,491	558,652	63.3	2,073,370	1,041,003	11,493,138	68,086,923	54.9
Braniff	192,623	92,835	56.9	403,133	200,480	1,011,823	10,511,943	45.9
Continental	115,079	82,920	48.8	258,327	124,143	619,087	8,947,802	40.8
Delta	294,919	179,265	56.3	634,276	398,965	1,809,985	20,039,186	48.2
Eastern	674,298	337,023	49.8	1,311,437	555,705	2,400,944	36,644,232	39.2
National	155,774	113,449	54.5	439,900	86,876	1,208,448	12,651,121	39.9
Northeast[2]	163,000	67,665	48.5	----	----	----	----	--
Northwest	177,948	122,707	56.8	647,257	245,790	1,223,089	20,360,462[3]	51.6[3]
Trans World	440,480	438,289	61.5	1,533,562	791,266	5,073,665	49,374,784	50.0
United	1,046,148	705,195	58.2	4,116,634	1,464,647	8,786,088	81,828,214	51.1
Western	165,213	100,447	60.2	324,243	104,065	362,776	10,400,178	47.0
INTERNATIONAL								
American	8,013	8,960	59.2	6,413	886	295,272	1,229,644	48.7
Braniff	9,999	13,671	58.8	66,110	----	157,100	1,654,550	49.6
Caribbean Atlantic	41,176	2,896	71.9	2,126	----	12,452	285,579	71.9
Delta	2,031	2,271	44.6	616	----	12,729	255,043	42.2
Eastern	48,105	69,169	69.6	136,593	----	359,606	6,961,138	64.2
Mackey	10,663	2,294	43.7	----	244	5,409	230,273	42.7
National	949	579	61.3	----	----	----	62,243	50.2
Northwest	22,327	39,248	56.1	1,721,614	----	758,115	----	--
Pan American								
Alaska	8,952	9,544	54.2	50,087	3,860	310,722	1,359,939	52.7
Atlantic	195,977	307,408	57.4	2,961,302	----	6,245,785	40,681,559	51.9
Latin American	134,437	179,341	72.1	485,552	----	4,667,698	23,845,739	71.4
Pacific	51,425	197,078	73.2	3,463,358	13,557	3,939,653	27,649,167	64.2
Panagra	11,859	20,523	63.4	91,695	----	644,370	2,926,002	61.8
South Pacific	199	543	39.7	440	----	1,496	56,988	36.4
Trans Caribbean	11,313	18,030	80.7	----	----	180,234	1,695,732	85.3
Trans World	35,677	118,550	50.7	1,467,130	----	2,222,121	15,795,642	49.4
United	25,323	63,058	69.6	383,060	11,275	199,614	6,996,791	57.0
Western	6,035	9,384	70.9	8,847	----	29,039	1,004,021	57.2
LOCAL SERVICE								
Allegheny	82,245	17,074	45.2	26,405	44,443	78,492	1,778,302	48.6
Bonanza	27,291	6,772	46.9	7,382	2,325	14,220	674,027	48.0
Central	23,719	4,560	36.6	17,231	9,109	37,540	500,624	36.1
Frontier	34,448	9,456	39.5	28,441	13,033	73,385	1,018,188	41.8
Lake Central	40,506	6,518	33.7	13,287	29,569	18,395	683,790	34.7
Mohawk	64,771	13,935	44.1	28,531	27,464	36,098	1,419,366	42.1
North Central	102,925	19,927	47.8	50,387	60,985	82,191	2,086,664	49.2
Ozark	50,544	9,037	45.1	21,971	33,926	47,677	977,611	50.7
Pacific	40,287	9,129	49.9	16,949	4,507	10,275	902,812	50.3
Piedmont	49,180	10,442	49.4	16,561	20,139	28,419	1,064,861	51.0
Southern	36,621	6,555	34.7	27,585	20,591	32,408	708,145	37.3
Trans-Texas	29,233	6,684	33.2	20,644	12,864	55,650	729,557	36.8
West Coast	35,616	8,713	45.6	15,348	6,909	24,948	879,380	45.9
HAWAIIAN LINES								
Aloha	47,549	7,143	72.6	3,062	----	5,308	580,398	60.9
Hawaiian	66,274	9,939	70.9	4,452	----	167,547	970,239	67.7
CARGO LINES								
Flying Tiger	9,936	43,920	82.5	16,907	25,175	9,947,125	14,413,243	79.0
Seaboard World	12,975	51,026	100.0	944,841	----	3,119,552	9,171,818	87.7
Slick	1,381	7,560	94.4	----	----	5,505,572	6,251,031	86.0
HELICOPTER LINES								
Chicago Helicopter	23,306	408	45.9	2,149	----	----	41,087	39.4
Los Angeles Airways	4,992	178	62.0	4,501	2,671	----	24,220	68.5
New York Airways	14,473	261	53.5	1,328	1,218	650	28,076	50.7
ALASKA LINES								
Alaska Airlines	6,303	5,029	43.3	60,511	2,806	423,340	1,014,721	57.4
Alaska Coastal	8,638	816	62.7	4,338	----	6,739	93,441	66.2
Cordova	3,478	429	49.8	5,497	----	36,511	85,599	55.3
Ellis	6,887	448	54.6	2,290	----	4,069	52,023	63.4
Kodiak	2,237	159	44.4	578	----	1,036	17,493	59.5
Northern Consolidated	4,421	1,454	46.3	63,095	----	98,356	319,842	67.0
Pacific Northern	17,044	16,696	64.8	161,322	8,860	490,551	2,463,845	75.9
Reeve Aleutian	2,035	1,863	49.6	68,105	----	148,669	421,013	67.5
Western Alaska	1,326	64	70.0	1,124	----	3,347	10,530	51.0
Wien Alaska	8,105	2,946	65.2	59,976	----	187,176	546,171	61.1
Avalon	18,534	697	56.9	952	----	1,349[1]	68,539	58.9

[1] Includes excess baggage ton-miles

[2] Northeast figures are estimates

[3] Combined domestic and international operations





The Boeing 727: a versatile, short-haul profit-maker

The trim new Boeing 727, now entering production, is a versatile airliner designed to operate *profitably* over route segments ranging from 150 to 1700 miles.

The 727's low operating cost will enable it to produce a profit at short ranges, even with modest load factors. Yet its generous cabin space (70 first-class or 113 tourist passengers) results in seat-mile economy on high-density routes, comparable to that of the largest jetliners.

The 727 will be a rugged jet capable of handling frequent landings and takeoffs. A 7000-gallon fuel capacity, plus high allowable landing weights, will enable the 727 to make frequent stops over a long distance without refueling. This and other features, such as an integral passenger stairway, will minimize service time during stops.

The 727's quick takeoff, fast climb and near-600 mph speed will result in block speeds never before attainable in short-haul operations.

Already, 117 Boeing 727s have been ordered by American Airlines, Eastern Air Lines, Lufthansa German Airlines and United Air Lines for delivery beginning late in 1963.

BOEING 727

CAB 'Use It or Lose It' Study Urged by Locals

Las Vegas, Nev.—Civil Aeronautics Board or Congress should make a comprehensive study of the desirability of changing the "use it or lose it" policy now applied to local air routes before deciding on route applications covering cities which have lost service under this policy, the Assn. of Local Transport Airlines concluded at its regional quarterly meeting.

Leslie Barnes, chairman of ALTA and president of Allegheny Airlines, told Aviation Week that if there is to be a new national policy on federal subsidized service to cities that cannot now be served economically, it should not be the byproduct of a route case.

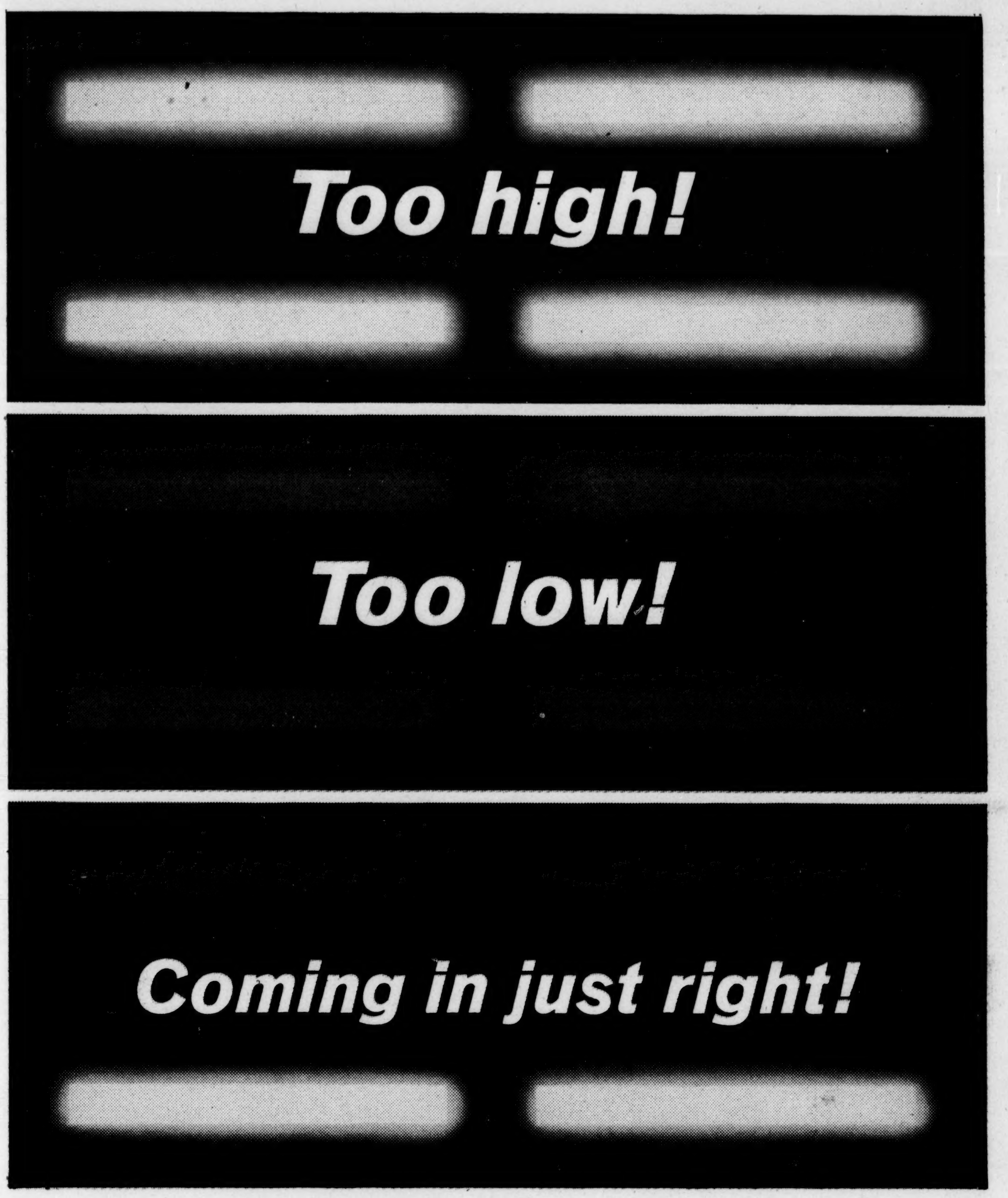
At issue is the possible creation of a "third level" of scheduled and subsidized air carriers by the CAB decision in the Hi-Plains case. Hi-Plains Airways is an air taxi operator in Hill City, Kan., which is proposing service with light twin-engine business aircraft to 47 cities in Kansas, Colorado, Nebraska, South Dakota and Missouri.

ALTA is urging that no "third level" be created to compete with ALTA members. CAB is scheduled to hear the Hi-Plains case next month. Exhibits have already been submitted. ALTA members say the case has as much national importance as the original creation of the "second level" local service airlines.

Barnes pointed out that local service carriers are bound by the board's "use it or lose it" policy to abandon service to communities which do not supply five passengers a day to their travel markets. Air taxi operators now bidding to provide scheduled and subsidized services are in many cases planning to serve communities dropped by local service carriers under the "use it or lose it" criterion. The criterion was originally set to minimize government subsidy by cutting out service anywhere its economic value approached zero. Barnes said that if the criterion is to be reduced or eliminated, existing local service carriers should be allowed to provide the service under the new basis.

A critic of the ALTA position accused the local service carriers of adopting the same arguments that were used against them by the big trunklines when the local service airlines were trying to get started. He told Aviation Week that the third-level operators are proposing to make scheduled service more economical for very small volume communities by using much smaller aircraft than the local service carriers.

Admittedly, the use of such aircraft will be complicated by Civil Air Regulations originally designed for larger, transport category aircraft.


Too high!
Too low!
Coming in just right!

Glide Angle doubt
is permanently out...

with Sylvania's Visual Glide Slope Indicator

Here's the remarkable new lighting system that makes landings safer and easier than ever before. It's the Sylvania Visual Glide Slope Indicator. Now being installed at major metropolitan airports. Veteran pilots praise it. Here's how it works.

When a pilot comes in too high, he sees a double bank of white lights on either side of the runway. When he comes in too low, he sees a double bank of red lights. When he comes in just right, *on the correct glide slope,* he sees one bank of red and one bank of white. It's a major advance in airport safety, and it's ready to work for you now. Conforms to applicable FAA and military specifications.

Whatever your airport lighting problems, Sylvania has the lighting system and technical assistance to solve it. For information write to Special Products Division, Sylvania Electric Products Inc., Estes Street, Ipswich, Mass.

SYLVANIA

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GENERAL SYSTEM

Raytheon solution for space

Recovery of space vehicles is a long range problem, commencing at atmosphere entry. Techniques for control from re-entry through touchdown, developed by Raytheon, are comparable to GCA concepts. Over the past two years, Raytheon has conducted a major and continuous investigation of the means by which a manned maneuverable space vehicle can be returned safely from flights in space to normal routine landing on earth. These investigations have included operational control concepts, instrumentation, information flow analysis, basic system requirements and subsystem specifications.

Part of this effort was a space vehicle recovery study for the Air Force Flight Test Center encompassing vehicle energy management, glider characteristics, trajectory analysis, flight parameter accuracies, range instrumentation, navigation, communications, data processing display, and human factors.

vehicle recovery: LONG RANGE GCA

Other portions of the effort included earth return navigation and recovery studies for SLOMAR (as a subcontractor to the Martin Company), and joint efforts with Bell Aerosystems Company on DYNA-SOAR Terminal Navigation Systems.

Currently, major emphasis is being placed on the APOLLO Ground Operational Support System (GOSS). This system will include global range instrumentation for tracking; telemetry and communications; and control, display and computation centers.

One of the world's largest scientific-industrial organizations, Raytheon has proven capability to create the required technology and manage every phase of a space vehicle recovery system — from early study and design through development, production and field support of operational systems and equipment.

Executive Offices, Lexington 73, Massachusetts.

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AIRLINE OBSERVER

▶ Fear of new wage increases in the face of dwindling profits is behind the airline industry's resistance to labor demands. Trans World Airlines, which had a $12-million net loss for first nine months of this year, has criticized the "wage push" as the most persistent type of inflation. Eastern, which has been issuing furlough notices to many of its ground personnel, estimates a 5% cut in its work force saves $600,000 each month. An average of industry expenses last year indicated that flight crew costs alone were about equal to the airlines' depreciation costs for flight equipment.

▶ Iraqi Airways Authority is completing negotiations to operate the aircraft fleets of all oil companies in the country. Recent talks have included the question of training Iraqi pilots and engineers in England so they can handle all maintenance and operations instead of foreign airway companies.

▶ Civil Aeronautics Board last week rejected a joint proposal by American Airlines and Eastern Air Lines to offer a new transcontinental service between Florida and California. Single plane service from Miami to San Francisco, via Chicago, would have created a new coast-to-coast service beyond that authorized by CAB last March in the Southern Transcontinental Service Case, the Board said.

▶ United Air Lines Caravelles have shown consistently high load factors of 85% to 90% in competition with piston and turboprop equipment out of Newark Airport (AW Oct. 16, p. 43). United is now waiting to see how the introduction of jet service at Newark by other carriers will affect this load factor. The Caravelle transport has a relatively high breakeven load factor.

▶ Hawaiian Airlines is employing glass fiber coating to combat interior corrosion on the airframes of its DC-3 all-cargo aircraft. Airline routinely hauls tuna fish, cows and horses over its inter-island routes and was replacing DC-3 fuselage bellies every 18 months due to resultant corrosion.

▶ Northeast Airlines is testing a new type fire warning indicator which operates on the "electric eye" principle. Majority of indicators now in use are triggered by a rise in temperature and have resulted in such a high percentage of false warnings that the Federal Aviation Agency plans to re-examine the adequacy of present systems.

▶ Complete Avro 748 turboprop transport airframe is undergoing full fatigue tests in a water tank at company's Woodford facility to determine failsafe properties involving pressurization, aerodynamic and landing gear forces. Cabin has been tested to 12.1 psi., double the working pressure, and airframe has been tested to 103% of ultimate design load in a static structural test rig. Three prototypes have flown for about 1,000 hours.

▶ Eastern Air Lines plans to apply to the Atomic Energy Commission for a license to use radioactive isotopes in non-destructive testing and safety inspection of aircraft. Company has been using X-ray, eddy current, ultrasonic sound waves and other methods for this purpose.

▶ El Al Israel Airlines, with a 51.9% load factor, is claiming the highest load factor among airlines flying transatlantic routes, for the first six months of this year. Revenue passenger miles increased 10% over the same period last year, while seat capacity showed a 34.5% gain. El Al reported a total traffic gain of 37% for the period.

▶ De Havilland Aircraft has put a security clamp on its Trident three-jet transport pending its first flight scheduled for December. Reason apparently is accelerating development of its competitor, the Boeing 727.

SHORTLINES

▶ **Aerovias Sud Americana** and Riddle Airlines have Civil Aeronautics Board approval for an arrangement that would permit Aerovias to lease Riddle aircraft for use over Aerovias routes, manned by Aerovias crews, pending the outcome of their proposed merger (AW Oct. 2, p. 41). CAB imposed a restriction prohibiting through plane service.

▶ **American Airlines** has transferred the New York portion of its service engineering department with its 60 employes to its Tulsa maintenance base.

▶ **Eastern Air Lines** will increase its weekend "Air Shuttle" flights between New York-Washington and New York-Boston on Nov. 11. New schedule will be six flights in each direction on Saturdays instead of four, and 12 flights instead of eight on Sundays between New York and Washington. New York-Boston flights will be eight on Saturdays and 12 on Sundays in each direction instead of the present six and 10 flights respectively.

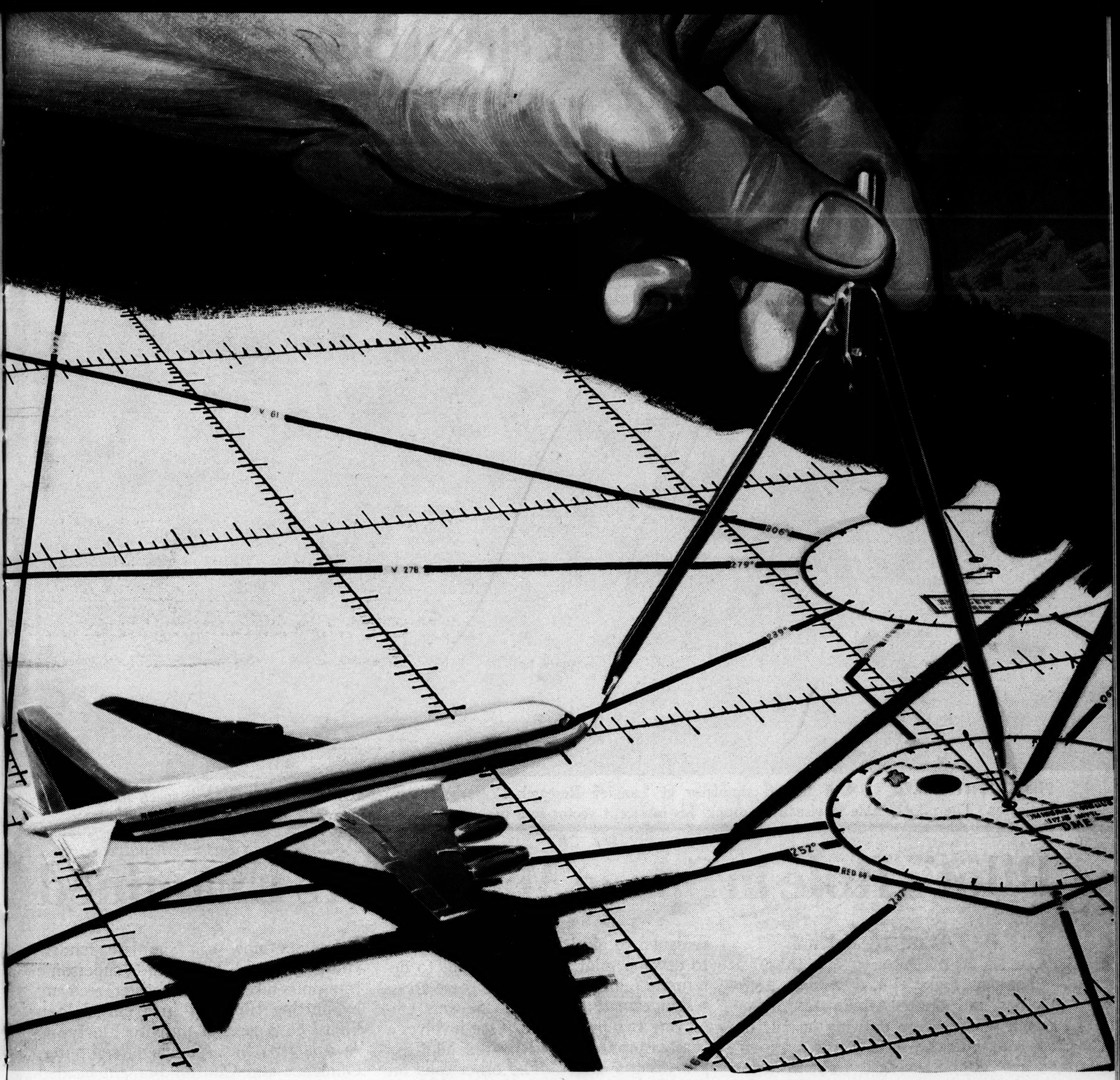
▶ **International Air Transport Assn.** reports its London clearing house, which handles members' interline transactions, did over $1.5 billion worth of business during 1960, an increase of more than 50% over 1959.

▶ **Local service airlines** flew over 876 million revenue passenger miles for the first eight months of 1961 compared with over 749 million during the same period last year, according to Air Transport Assn.

▶ **Northwest Airlines** reports a net income of $614,222 for September compared with $393,272 for the same month last year. Increase came in spite of a drop in operating revenues from $11.4 million in September, 1960, to $11.1 million last September.

▶ **Pacific Northern Airlines** has CAB guarantee for a loan to buy one Boeing 720 jet transport for scheduled service next May. Guarantee was made on basis that with the jet, the carrier would not need subsidy after April, 1965. The airline is buying another 720 not covered by a loan guarantee.

▶ **Trans World Airlines** last month flew its last international passenger flight with piston equipment. Flight was between New York and Rome with a 1649 Lockheed Constellation. All of TWA's international passenger flights are handled by nine jet transports which replace 24 piston aircraft.



COLLINS DME PINPOINTS POSITION CONTINUOUSLY

1
115
NAUT. MILES
2
039

Adoption of the newest advance in aircraft navigation — Distance Measuring Equipment — is already paying dividends in cockpit efficiency, operational economy and traffic utility. As the major manufacturer of Distance Measuring Equipment, Collins has been the exclusive choice by 11 of the nation's key airlines. The Collins 860E-1 DME provides accurate, instantaneous and continuous position information throughout flight. It permits the pilot to rapidly determine ground speed and ETA's and to efficiently execute holding patterns, orbital by-passes, traffic maneuvers and weather detours with ease and confidence.

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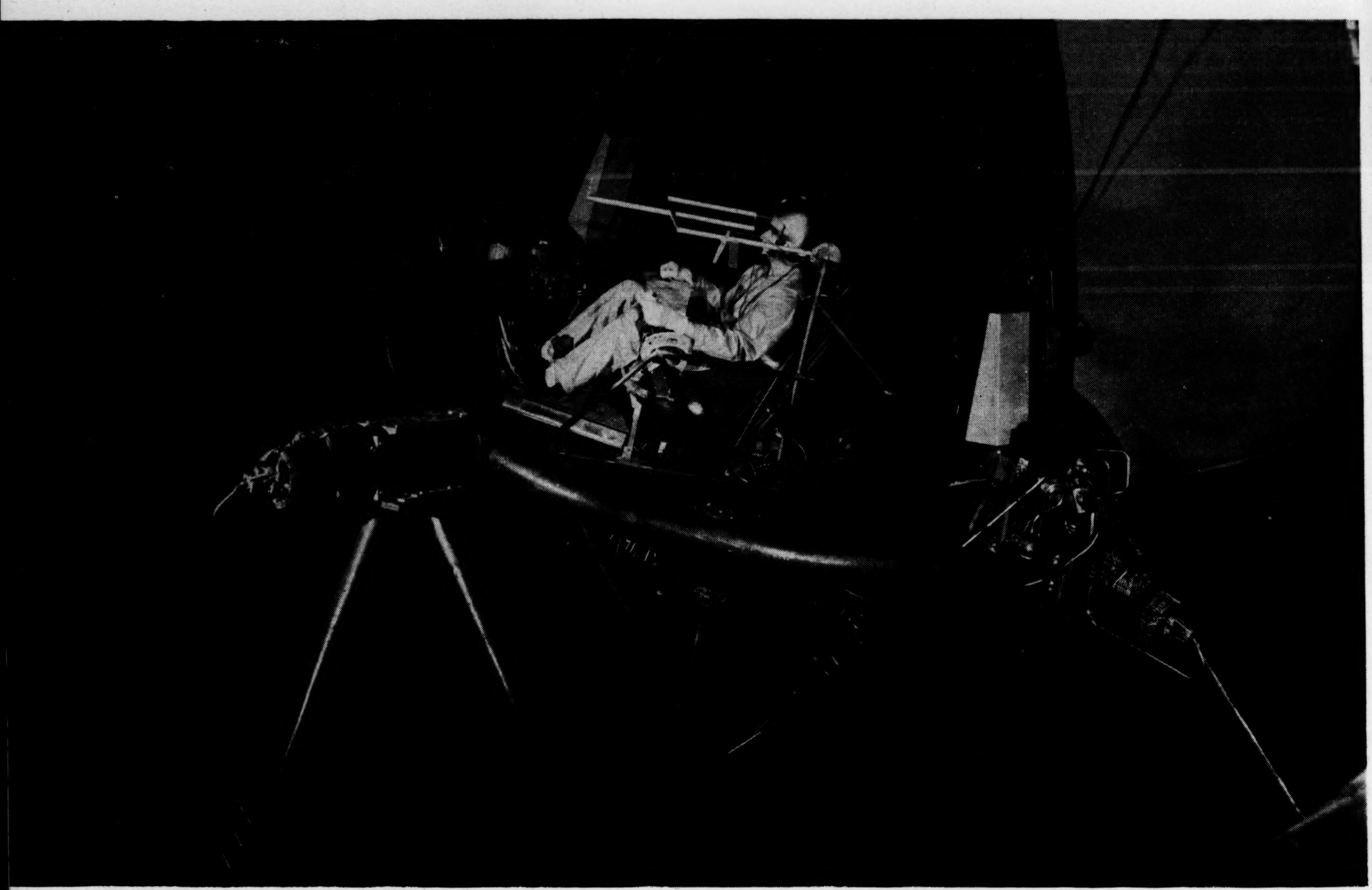


PILOT-CONTROLLED LUNAR takeoff simulator at Langley Research Center uses a three-axis chair and a two-axis space station target projector. The pilot is able to visually compute his intercept vector in a lunar rendezvous maneuver.

Pilot's Role in Space Maneuvers Examined

By Edward H. Kolcum

Langley Field, Va.—National Aeronautics and Space Administration research scientists are drawing heavily on airplane guidance and control experience to establish a basic framework for simulating rendezvous and docking operations and lunar landing and takeoff techniques.

The basic philosophy of a broad new space simulator program here is to give the pilot the same degree of responsibility he has in an aircraft, not to rely on him solely as an astronaut-observer backup for "black boxes."

Arthur W. Vogeley, assistant chief of the Guidance and Control Branch of Langley Research Center's Aerospace Mechanics Division, contends that many in the rocket business don't realize the ability of the pilot. Reliance on pilot response to visual cues, such as chasing a flashing light in the terminal rendezvous phase, can eliminate heavy and complicated electronic and infrared homers, and increase chances of success several hundred per cent, Vogeley feels. Langley's simulator program is designed to give the center a capability to develop pilot techniques, and to determine pilot limitations, in these areas:

- **Rendezvous terminal maneuvers** employing two procedures. One involves a chaser ship controlled by the pilot approaching a target. The other calls for the pilot to control the chaser to his spacecraft.
- **Docking two vehicles** while in orbit. Once the terminal maneuver is successfully completed, Vogeley said, the docking maneuver will be easier than mooring a ship in heavy seas.
- **Lunar landings** and takeoff, which under Langley studies would follow helicopter landing techniques with combined horizontal and vertical velocity increments.
- **Re-entry maneuvers** with both winged boost-glide configurations and semi-ballistic Apollo shapes.
- **Booster recovery** in which a pilot controls a Rogallo wing to bring a spent launch vehicle back to earth for re-use.
- **Takeoff procedures** for supersonic transport carriers. This program is tied to a supersonic transport landing simulator at NASA's Ames Research Center.

Langley now can simulate rendezvous, re-entry, lunar and supersonic transport takeoff and booster recovery by putting the pilot in a closed loop linked to a general purpose Electronic Associates, Inc., analog computer. Guidance and Control Branch, headed by W. H. Phillips, has devised an inflatable planetarium to add realism to the simulated maneuvers.

A picture of the lunar surface is projected on a screen in lunar landing simulation, and the picture grows or decreases in relation to altitude. In rendezvous studies, Langley uses a star background and the objective spacecraft is a flashing light.

Earlier this year, Edgar C. Linberry and Max C. Kurbjun of the Guidance Branch developed a star pattern guidance sight to eliminate complex, heavy hardware. The scope is fixed to a distant star and to the target vehicle, and the relative motions between target and chaser can be monitored continuously. If the pilot is not on a collision course, the target will drift rapidly away from the reference star.

Kurbjun said that after several runs

with the visual display, it has become apparent that the pilot is able to detect angular rates more accurately by eye than by instruments.

New Simulators

NASA will extend Langley's simulator capability with two sizable facilities, one a docking device to be located in the old Flight Research hangar, and the other an outdoor lunar landing device (see photograph) both to be completed by February, 1963. Construction will begin early next year and will cost an estimated $3.5 million.

Docking simulator will be a cable-suspension arrangement able to traverse over 200 ft. of the hangar, with a target ship capable of three lineal and three rotational motions. A ground cart will simulate the chaser and will go through one degree of lateral and three degrees of transverse motion.

Lunar landing research facility will be 400 ft. long, 50 ft. wide and 200 ft. high. It is being designed to accommodate full-scale Apollo lunar landing configurations, and may possibly serve to check the flight article before the lunar mission. The overhead support system will be servo-driven to assure that the support cable remains true vertical.

The device will simulate 50 fps. horizontal and 30 fps. vertical velocity increments. A gimbal system will allow freedom in pitch, roll and yaw.

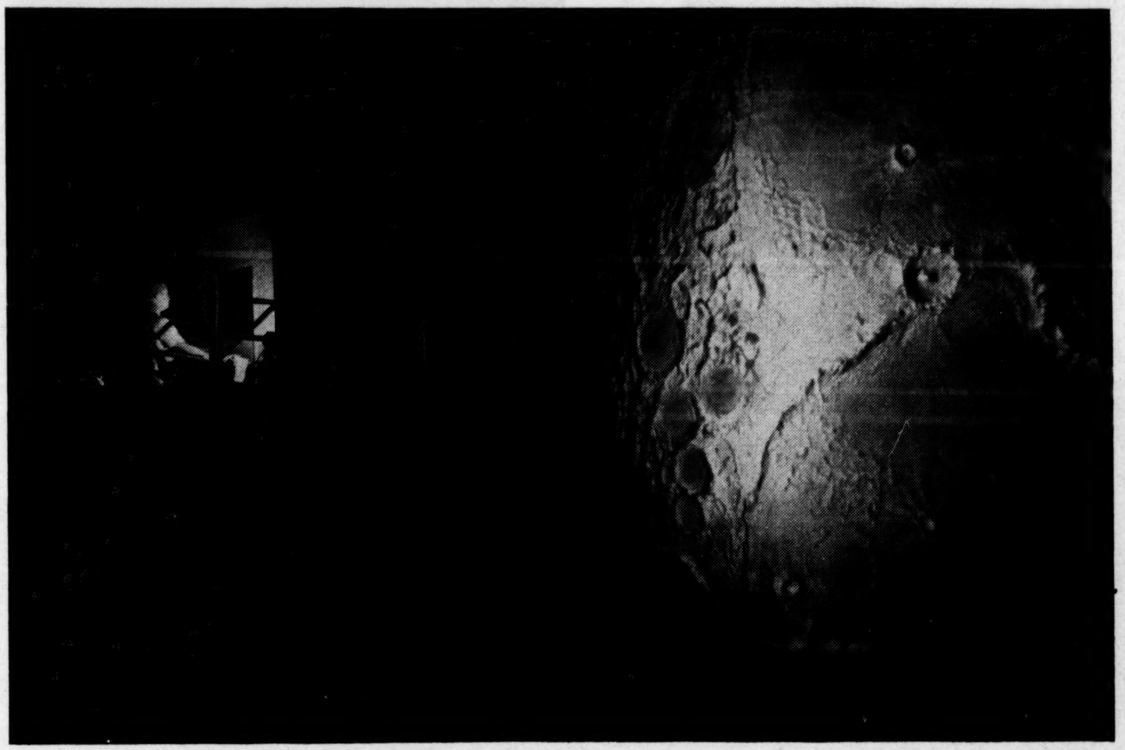
One of the most fruitful results of the Langley simulator design program has been exhaustive studies in rendezvous potentials and problems which have evolved into at least one unique theory that could accelerate the Apollo lunar landing mission.

Lunar Rendezvous

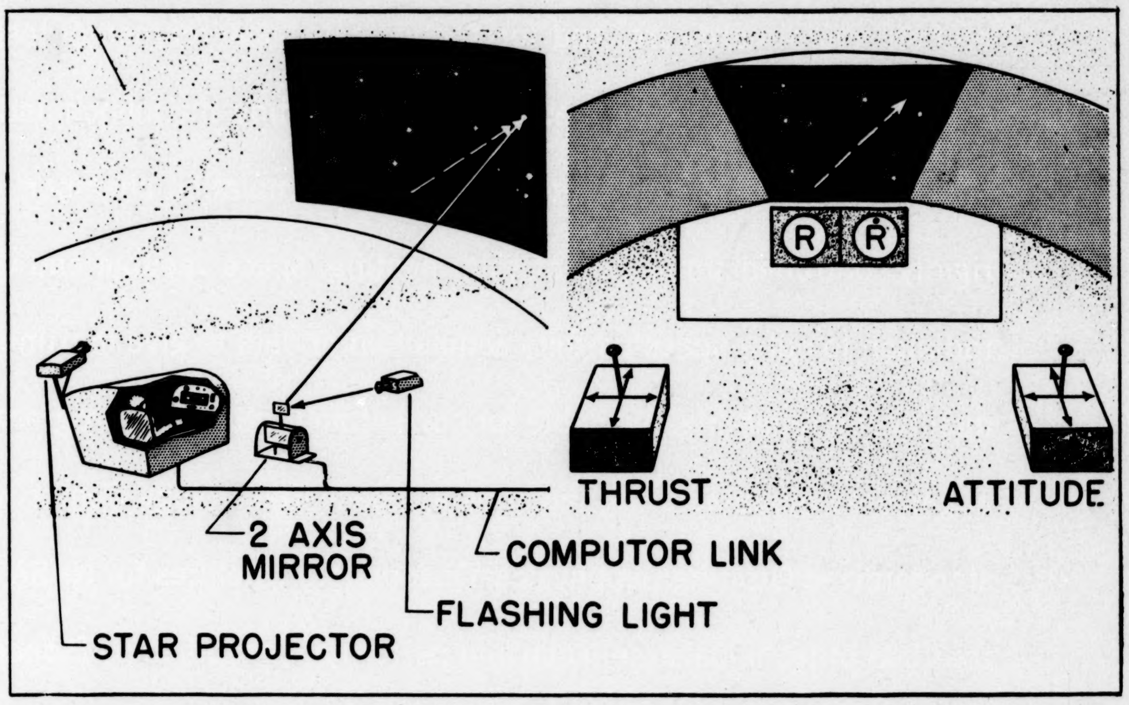
The concept is a lunar rendezvous, as opposed to the generally-favored earth rendezvous. Procedure would be to launch several C-3 vehicles to a direct lunar orbit, assemble the lunar landing vehicle while in a lunar orbit, and eject the lunar lander, which would rejoin the lunar orbiter after its mission.

Earth rendezvous would involve essentially the same procedures, but the lunar lander in this method would be launched from an earth orbit. Most attractive features of the lunar rendezvous are:

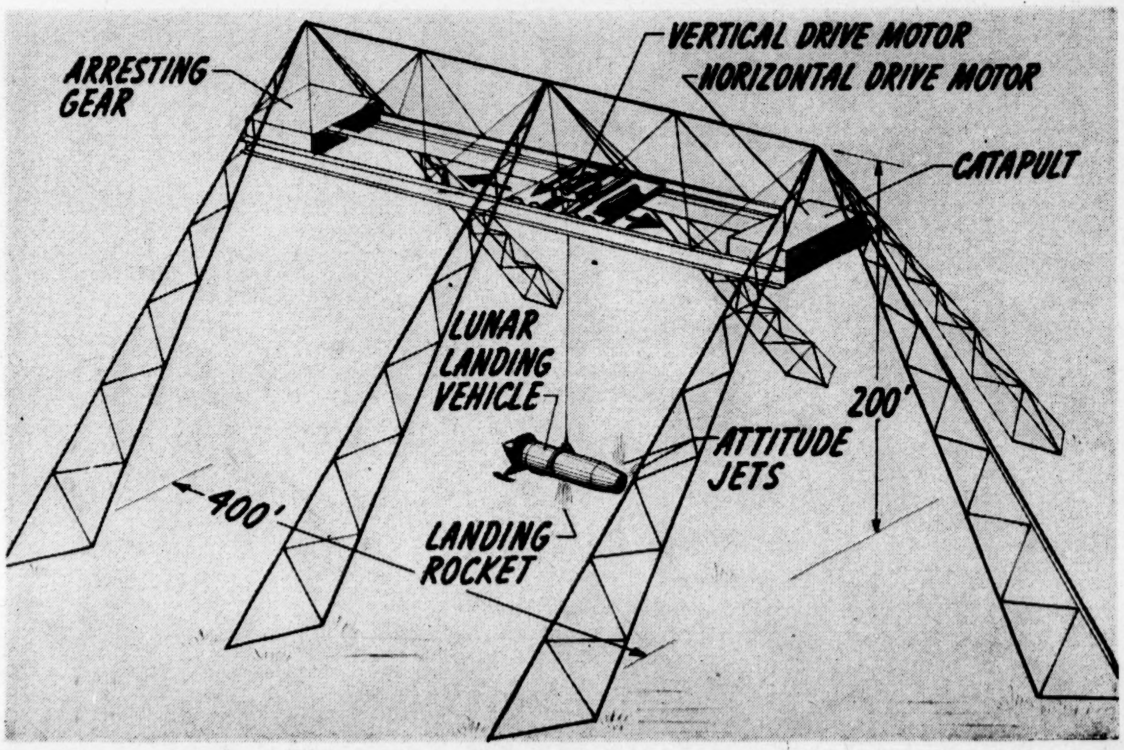
- **Schedules.** All development work can be done with the Saturn C-1 launch vehicle and all missions can be flown with the C-3. The C-3 is a cluster of two Rocketdyne F-1 engines, each developing 1.5 million lb. thrust. If NASA goes the C-4 route, this would increase the lunar rendezvous reliability. NASA expects to select either the C-3 or C-4, which is a four-engine F-1 cluster, for rendezvous technique development.
- **Guidance,** both for intercept and launch. Velocity increment for earth



HUMAN ABILITY TO CONTROL braking maneuvers for lunar landings is simulated through a hydraulic analog computer at Langley Research Center.



TERMINAL PHASE of rendezvous is simulated in two techniques using computer links. At left is remotely controlled chaser, at right is piloted chaser.



MANNED LUNAR LANDING SIMULATOR, to be built at NASA's Langley Research Center, will handle vehicles up to 20,000 lb. with rocket thrusts up to 50 fps.

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STL has moved to its Space Technology Center, built on a 110-acre site at Space Park, Redondo Beach, California. This new industrial complex is designed specifically for research, development, fabrication, integration and test of spacecraft, subsystems, components and ground support equipment for manned and unmanned space missions. A major feature is the high-bay manufacturing building which provides complete facilities for the manufacture of electronic, mechanical and structural hardware, and for sophisticated environmental testing employing a broad spectrum of simulated conditions affecting the launch and performance of spacecraft. In the thirty-foot diameter space simulation chamber, rigidly controlled simulation of solar heating, space vacuum and vehicle heat radiation to outer space permits acquisition of data to give maximum assurance of quality and reliability. Available for current and future STL programs, the augmented manufacturing facilities at Space Technology Center will soon be producing standardized Orbiting Geophysical Observatory satellites for NASA, in the tradition of technical excellence and performance typified by Pioneer V.

SPACE TECHNOLOGY LABORATORIES, INC.

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rendezvous requires the chaser to catch a target traveling at 25,000 fps. This is reduced to 5,300 fps. in a lunar rendezvous. Earth rendezvous will require precise guidance and probably heavy correction rockets, while at the lower lunar rendezvous velocity the terminal phase can be made visually, and corrections could be made with relatively small solid propellant rockets.

- **Techniques** for lunar and earth rendezvous are identical in terminal and docking phases, and the lunar-type can be developed in earth satellite flights.

Direct flight to the moon with a Nova vehicle—boosted by eight F-1 engines—will mean a compromise of the lunar landing module to assure reliability of the re-entry vehicle, Vogeley said. With rendezvous, either earth or lunar, re-entry and landing vehicles can be developed simultaneously and design of one would not have to be sacrificed for the other, since they could be launched by separate vehicles.

Rendezvous Techniques

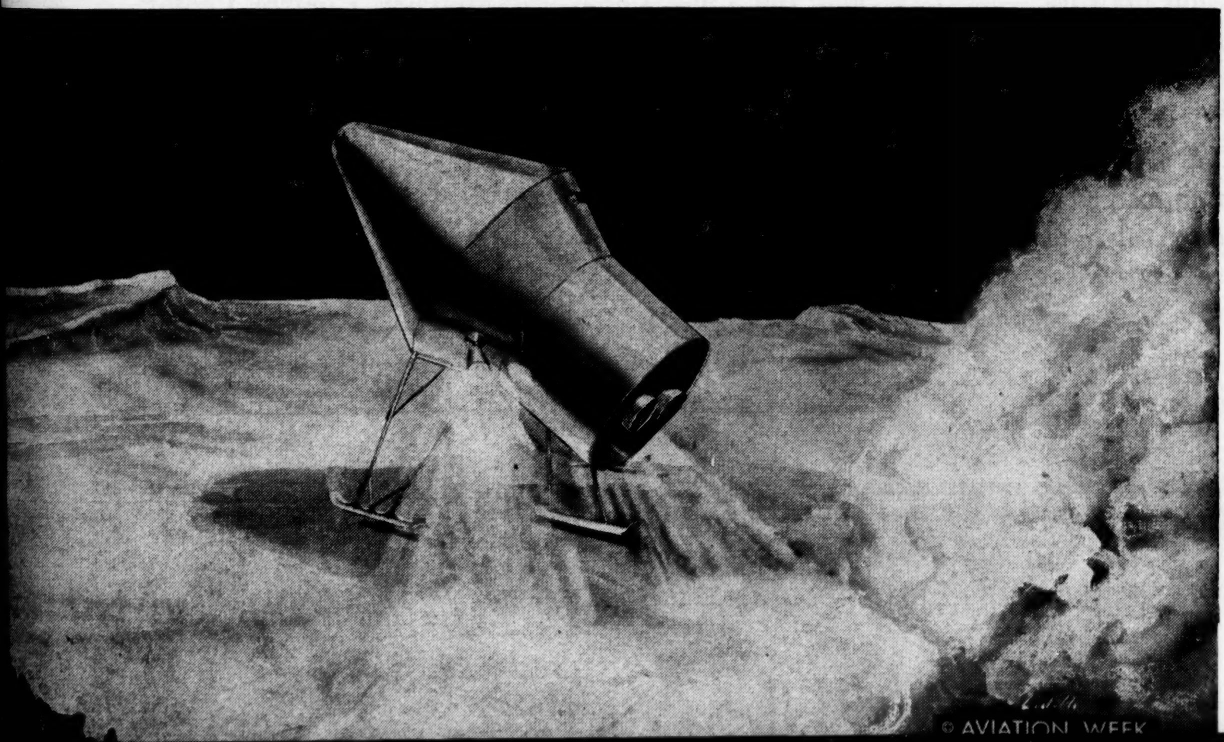
John C. Houbolt, associate chief of Langley's Dynamics Loads Division, has summarized these five ascent injection techniques for rendezvous:

- **In-plane** and compatible orbit, in which the ferry vehicle is launched to an orbital plane the same as the target. Long waits, sometimes a month or more, might be required to eliminate large amounts of orbit-correction fuel in the direct in-plane technique. Compatible orbit would put the target overhead once or twice a day, and the chaser could rendezvous at these times. For compatible orbits, the satellite rotation, precession of the orbital plane and earth's rotation would be computed simultaneously.
- **Parking orbit**, in which the chaser is launched to a low orbit and gains on the target angular position because of its faster period. When the angular positions are the same, the chaser is boosted out of the sub-orbit to rendezvous with the target.
- **Out-of-plane** adjacency, which may be necessary because the launch site is out of the target orbital plane. The chaser is launched so that it will be at the same altitude and velocity as the target at injection, but at a different inclination. When the planes cross, direction of the chaser is changed to coincide with that of the target.
- **Two-impulse**, in which the ferry is launched on a ballistic trajectory designed to meet the target path near apogee. At apogee, a second impulse is given the chaser which simultaneously changes its direction and increases velocity so that it intercepts the target.
- **General injection**, in which the ferry is launched so that it follows a Keplarian trajectory during coast to intercept the target. A second impulse would be required to make velocity and direction coincide with the target.

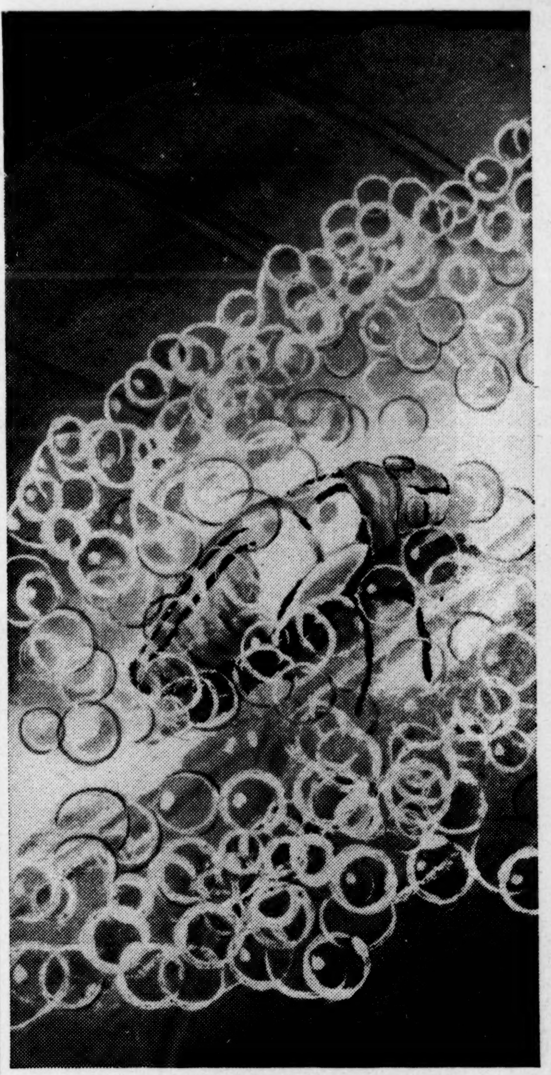
The rendezvous simulation studies at Langley have concentrated on the terminal phase in which corrections are made to adjust the final orbit. But the Guidance and Control Branch has extended its research to the lunar landing portion of the mission which will utilize both helicopter and X-15 experience.

Velocity of the lunar rendezvous significantly is within the X-15 flight envelope, and the Langley concept plans major dependence on the pilot for reliability. Since pilot decisions are assumed, pilot visibility must be assured. As a result, the idea of a vertical landing may prove prohibitive if the lunar surface is covered with a dust layer.

Langley is looking at a helicopter landing technique in which the spacecraft descent rocket is used not only to attenuate impact shock, but also to blow the lunar dust away. The descent rocket may be sized as a backup for lunar launch and for an abort to get away from the moon quickly, and it could be gimballed for its braking application.



MANNED LUNAR LANDING technique would be similar to a helicopter descent. Braking rockets will blow lunar dust away from the landing spot and the vehicle will land on skids with some forward momentum.



Engineered Environment

Although vulnerable to heat, the spittle bug can blow himself a cooling bubble bath and thus "tailor" his environment to suit his needs.

Tailoring of environment is a vital requirement that must be built into today's weapons systems. Answering this need is specially designed AAF equipment for controlled environment. For example, AAF-engineered air conditioners were developed for the APCHE system. The units are installed in mobile vans used for prelaunch checkout of the Atlas missile. They provide conditioned air for personnel and for sensitive electronic equipment in the van.

Other AAF equipment supporting modern weapons systems include heating equipment utilizing various fuels or electric power, also packaged liquid chillers, heat exchangers, specialized blowers. You can increase your system reliability with AAF know-how and equipment.

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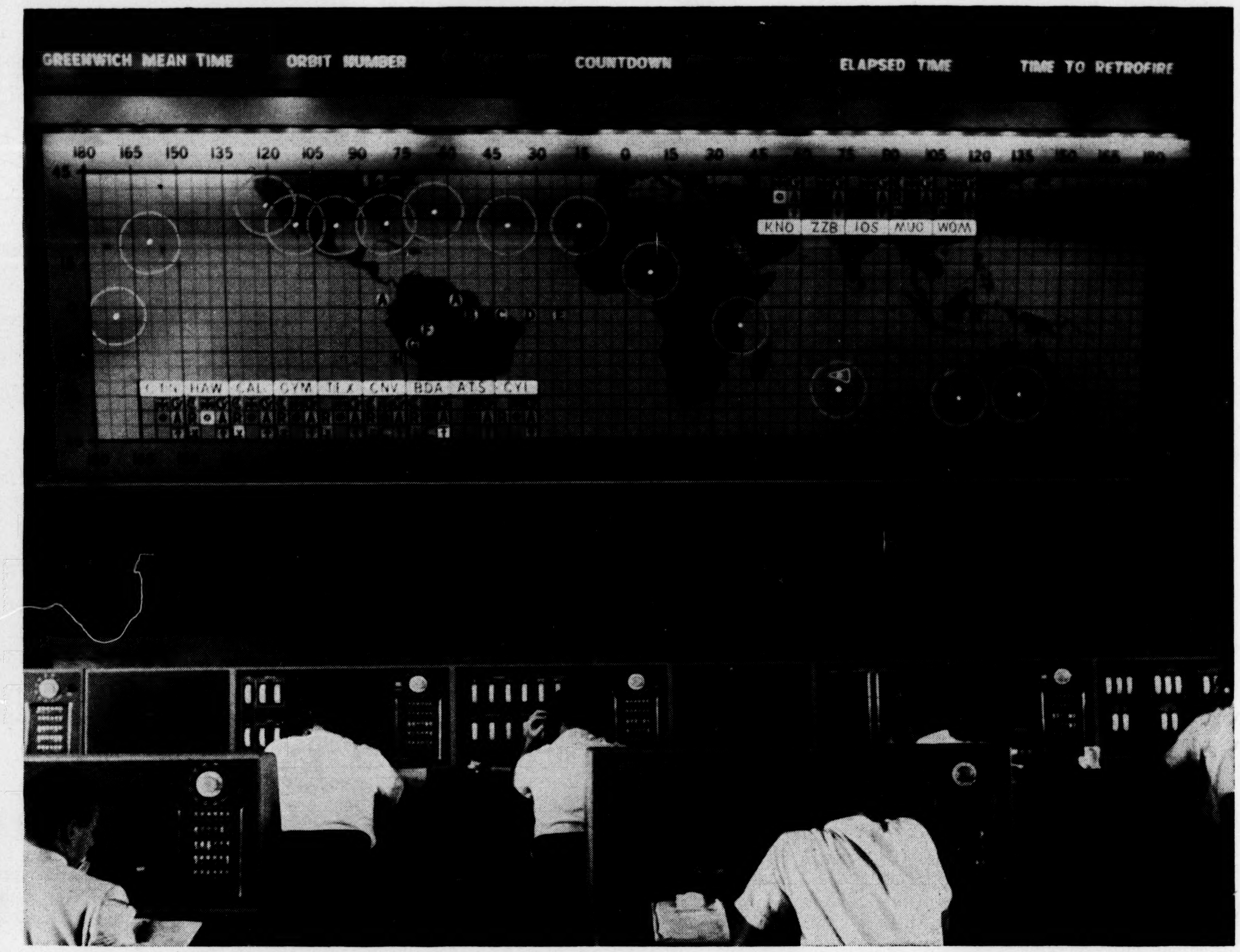

In Mercury Control Center room at Cape Canaveral, designed under supervision of Bell Telephone Laboratories, NASA flight controllers make all vital decisions concerning a Mercury mission. Large map displays equipment status at tracking and communications sites, preferred recovery areas, the position of the capsule and its "immediate impact point."

Bell System manages building of global communications network for Mercury spacecraft

On September 13, National Aeronautics and Space Administration first achieved the orbital flight of an unmanned Mercury spacecraft, using a new world-wide communications and tracking network.

Soon, will come manned orbital flight.

The Bell System has played a large role in the development of this scientific project.

Western Electric headed an industrial team, on which Bell Telephone Laboratories also played an important part, in building the world-wide network of tracking and monitoring stations.

This 60,000-mile communications route, the bulk of which is teletypewriter and telephone circuits, ties together 17 tracking and instrumentation sites with the Goddard Space Flight Center in Greenbelt, Md., and the Cape Canaveral Mercury Control Center.

As a Mercury capsule orbits over the area covered by each site, the far-reaching communications network immediately begins feeding information received from the capsule with clockwork precision. So fast and efficient is this communications system, it takes only seconds for data to start flowing from any site through Goddard to Canaveral!

The Bell System is proud to have contributed its creativity and resources to this vital project and to the further advancement of global communications.

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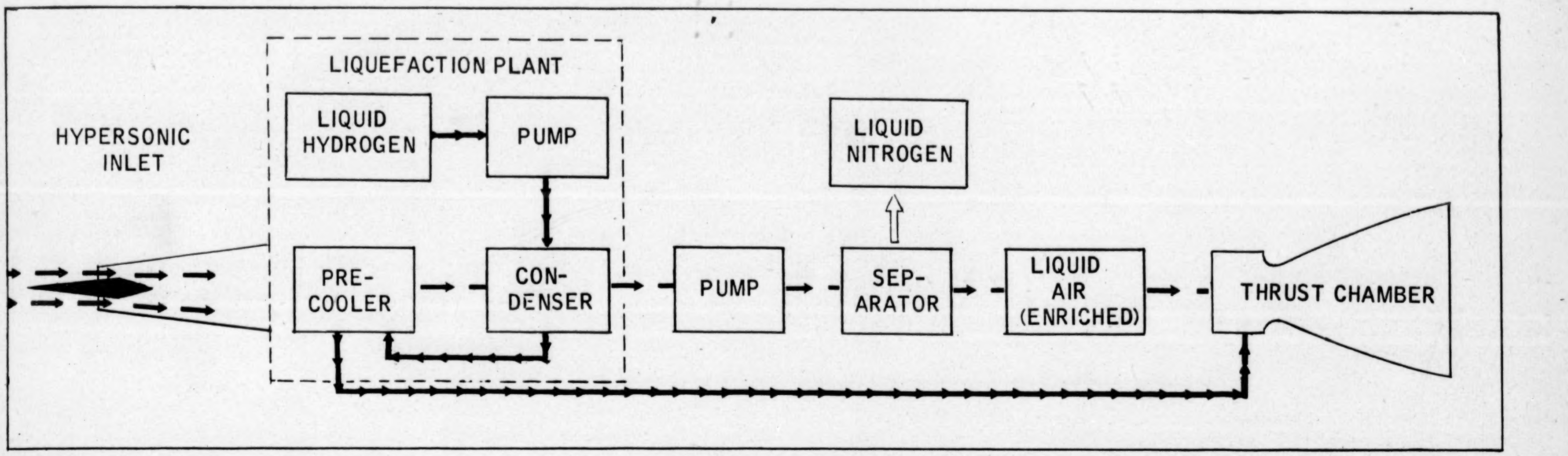


SCHEMATIC DIAGRAM OF LACE concept shows air flow from hypersonic inlet, through various stages to thrust chamber.

LACE Concept Feasibility Proof Sought

By David A. Anderton

New York—Systems engineering aimed at proving feasibility of the concept has begun on Marquardt Corp.'s liquid-air cycle engine (LACE).

One of a number of possible and proposed powerplants for USAF's Aerospace Plane concept (AW June 19, p. 54), LACE is basically a rocket engine operating on liquid hydrogen as fuel and liquid air as oxidizer. The liquid hydrogen is carried along as part of the gross load of the vehicle, but the liquid air is manufactured from atmospheric air scooped out during flight and condensed by a refrigeration process using liquid hydrogen as the coolant.

A further development of the concept which is called NULACE (nuclear liquid-air cycle engine) combines the LACE concept with a nuclear rocket engine such as Rover to obtain calculated specific impulses twice that of the nuclear rocket alone.

Both these Marquardt concepts are aimed at achieving economies in the costs of putting payloads in orbit or beyond. Company calculations show costs on the order of $20 to $50 per pound in orbit, which compares with about $1,500 per pound in orbit today using Discoverer vehicles. Marquardt says these economies can be traced to the engine performance which can show specific impulses which are multiples of those obtainable with liquid-propellants or nuclear rockets.

Engineering Team

Two firms with specialized and complementary experience are now working with Marquardt in LACE systems engineering: Garrett Corp., responsible for heat exchanger work, and Rocketdyne Division of North American Aviation, responsible jointly with Marquardt for development of the regeneratively cooled thrust chamber but solely responsible for the liquid hydrogen pumping system.

Marquardt engineers also are working informally with several airframe project teams interested in using the cycle in their proposals for Aerospace Plane. The company's position is still strong, because the LACE concept is original with Marquardt as one outgrowth of its continuing work on advanced airbreathing powerplants. But the company expects competition in the near future from Pratt & Whitney Division of United Aircraft Corp. on the basis of that group's experience with liquid-hydrogen propulsion. General Electric Co. is also expected to provide some serious competition at a later date.

Feasibility of both LACE and NULACE concepts no longer is a question in the minds of Marquardt engineers. The company has stated that progress in both programs is ". . . most encouraging, and component performances already achieved suggest that no major technological breakthroughs are required."

But outside the company there are both doubts and support. Strongest support for the LACE concept comes from Air Force Systems Command's Aeronautical Systems Division, where the Aerospace Plane project comes under the direction of Col. A. L. Wallace, Deputy for Technology (AW Sept. 25, p. 189). There is skepticism at higher levels in USAF and Department of Defense, particularly in the latter organization which is suggesting that systems engineering be deferred until feasibility is definitely proved.

Marquardt sources feel LACE is supported with enough USAF funding so that feasibility can be definitely established in tangible form. First tests of burning of hydrogen in liquid air have been made in an 18-in. thrust chamber. Heat-exchanger hardware is in existence. Rocketdyne's Mk. 4 liquid hydrogen pump, proven earlier in work on the Project Pluto nuclear ramjet program, is being adapted to the LACE cycle.

Currently, tests of portions of the system are being made in Cornell Aeronautical Laboratory's 48-in. hypersonic tunnel, under a $110,000 contract. Test work began in September, and the contract ". . . covers lots of testing" according to a laboratory spokesman.

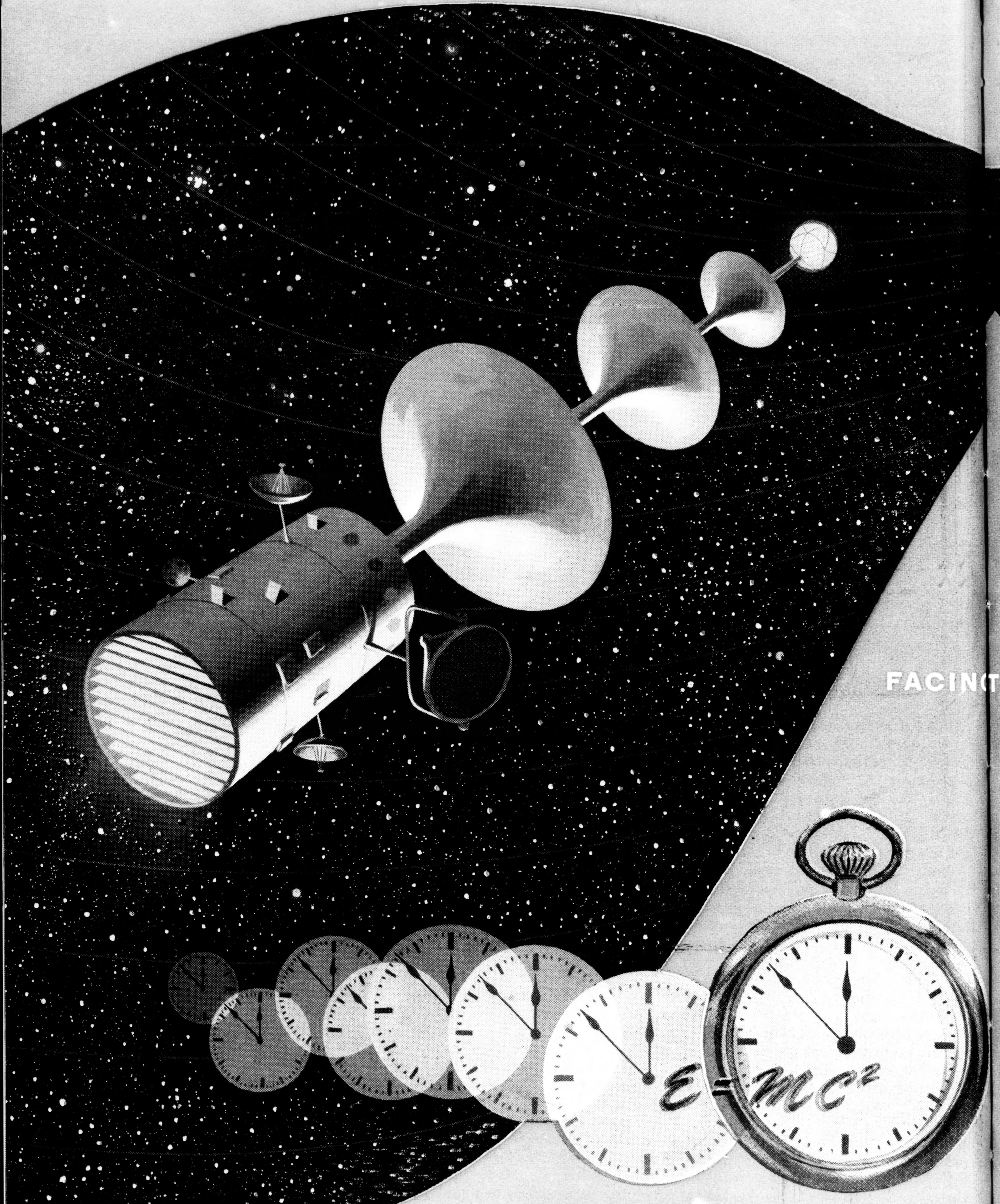
For future testing, portions of the system could be flown through their design environment on ballistic trajectories as part of a rocket payload. Specifically, the heat exchanger lends itself to this kind of testing, because only a portion of its full-scale geometry need be tested to establish operating characteristics. No specific research rockets are assigned to test the system in that manner, but there are proposals describing that way of testing as essential to final proof of feasibility.

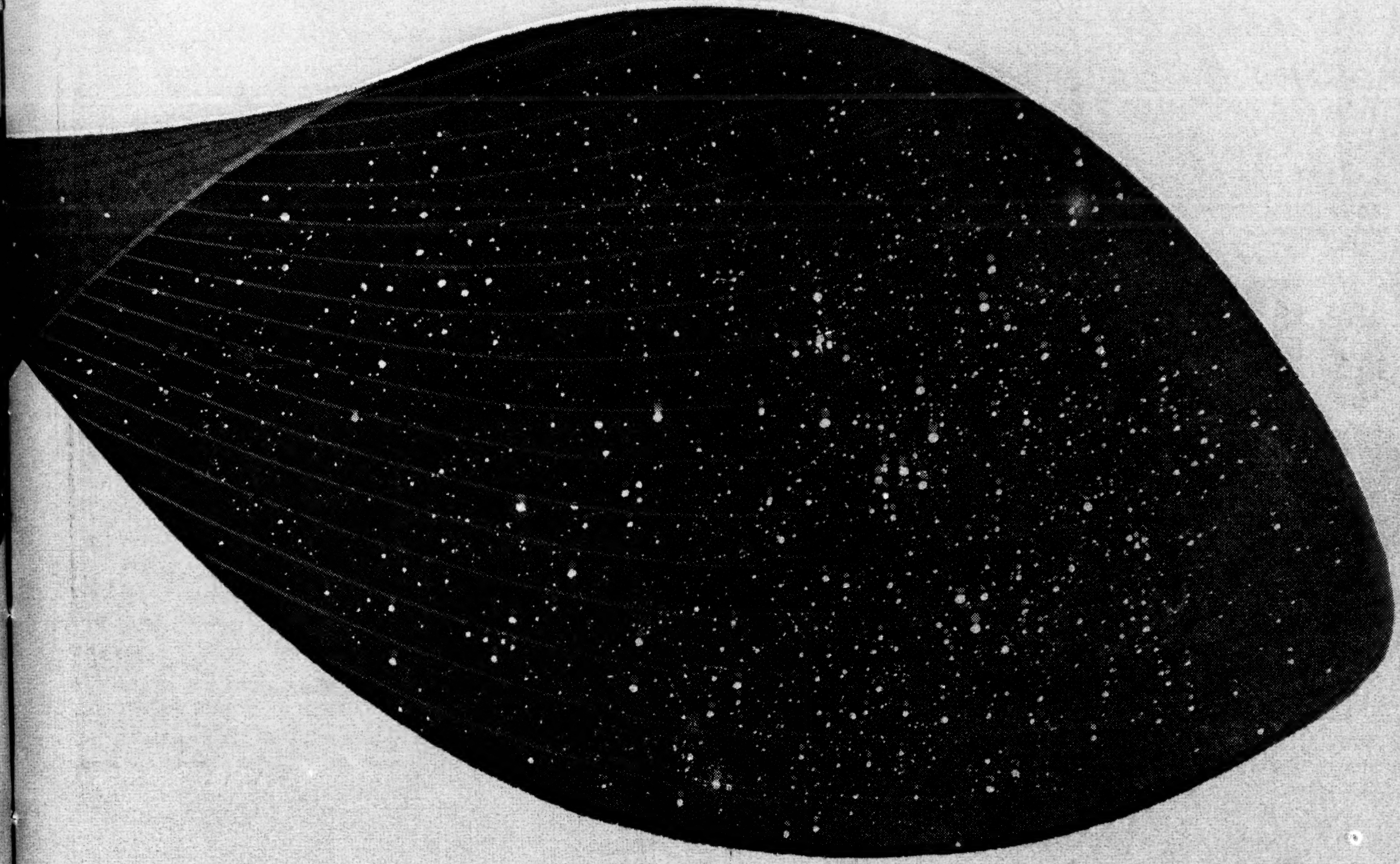
Cycle Details

LACE is basically a rocket powerplant burning liquid hydrogen in liquid air. It differs from other rocket propulsion proposals because it carries only its fuel off the ground as part of the vehicle's initial weight. It manufactures its oxidizer during a transitional portion of the vehicle total flight path.

Liquid hydrogen serves a dual purpose: it is fuel for the rocket engine, and it is coolant for the heat exchangers which are part of the liquid-air manufacturing cycle. According to a schematic diagram shown in model form by Marquardt at the recent American Rocket Society Space Flight Report to the Nation (AW Oct. 16, p. 26), the liquid hydrogen circulates from the storage tank through a refrigeration plant and then goes to the thrust chamber.

Air scooped in by the engine inlet system passes first through a pre-cooler and then through a condenser which liquefies the air. It passes through a pump which raises its pressure to a high level, and then goes through a separator which presumably gets rid of some of the liquid nitrogen. This enriched liquid air is then pumped to a


$E=MC^2$



THE FOURTH DIMENSION IN PROPULSION DEVELOPMENT

Whether the universe has a "saddle shape," or any shape at all, is a matter of interesting conjecture. The matter of space travel, however, is the subject of intense experimentation. A nuclear/thermionic/ionic propulsion system, currently being studied at Lockheed Missiles & Space Company, might well become the power source for space vehicles.

Its design incorporates a nuclear reactor only one foot in diameter, generating heat at a temperature of 1850°K. This is transmitted to banks of thermionic generators, converting the heat directly into electrical energy for the ion beam motor which uses cesium vapor as a fuel. The entire system is designed without any moving parts, minimizing the possibility of failure.

Lockheed's investigation of propulsion covers a number of potential systems. They include: plasma, ionic, nuclear, unique concepts in chemical systems involving high-energy solid and liquid propellents, combined solid-liquid chemical systems. The fundamentals of magnetohydrodynamics, as they might eventually apply to propulsion systems, are also being examined. Just as thoroughly, Lockheed probes all missile and space disciplines in depth. The extensive facilities of the research and development laboratories—together with the opportunity of working with men who are acknowledged leaders in their fields—make association with Lockheed truly rewarding and satisfying.

Lockheed Missiles & Space Company in Sunnyvale and Palo Alto, on the beautiful San Francisco Peninsula, is an exciting and challenging place to work. For further information, write Research and Development Staff, Department M-24A, 962 West El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required. An Equal Opportunity Employer.

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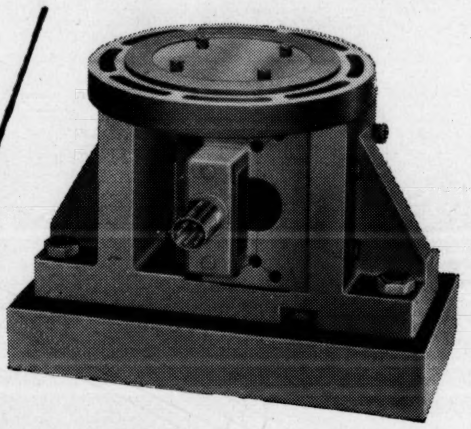

This test stand for miniature rocket motors loaded with experimental, high impulse propellants was designed and built by FluiDyne around the Flex-Cell. Motors are directly attached to the Flex-Cell via the circular adaptor plate eliminating the need for additional alignment devices or flexures. Rated capacity is 750 pounds with overload protection to 75,000 pounds.

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storage tank for later use as oxidizer in the rocket engine thrust chamber.

All this operating cycle presupposes that the complete system is flying at hypersonic speeds in some kind of a flight path which is low enough to furnish the requisite amounts of air, yet high enough to avoid aerodynamic heating. One indication of the parameters of such a path is given by company studies made for Marquardt's Field Research Laboratory at Saugus, Calif. Those studies were aimed at finding ways to test at Mach 14 and 240,000 ft.

Powerplant Applications

Most obvious application of the LACE system is to Aerospace Plane, a hydrogen-airbreather type of aircraft which is intended to carry cargos by standard methods from conventional runways directly into orbit. In such a design, LACE would only be one part of the over-all propulsion system which might use a hydrogen-burning turboramjet for takeoff, climbout and acceleration to hypersonic speed. At this point, the engine configuration could be changed to that of a true supersonic ramjet—a concept that Marquardt has also explored thoroughly and continuingly—with internal burning at supersonic gas through-put velocities.

Finally, this combination could keep the air vehicle in flight until sufficient oxidizer had been accumulated to complete the rest of the mission using the power of the LACE system.

Greatest advantage of the LACE cycle is its delivered specific impulse over the entire flight path. Marquardt says that the ordinary range of the comparison between LACE and out-of-atmosphere rockets is four to one in favor of the air-breather.

This argument and other analyses made by the company have shown that large-scale utilization of space will demand single-stage, recoverable aerospace vehicles or orbital aircraft. With the higher specific impulses available, the practical result is that a vehicle arrives in orbit with a correspondingly larger fraction of its gross weight. This means more payload in orbit for a given gross weight on the earth's surface.

The need for increasing the ratio of payload to gross weight is pointed up by simple figures for a rocket vehicle burning liquid oxygen and liquid hydrogen near the stoichiometric ratio. At takeoff, the weight of liquid oxygen is more than 80% of the total propellant weight, which in turn is the major portion—on the order of 95%—of the gross weight of the total rocket vehicle.

Obviously if the oxidizer could be manufactured at some point in flight, and could be done so with relative ease, the weight saving could be huge.

Marquardt says the earliest, most primitive vehicles are expected to show a doubling of the weight fraction in orbit, compared with rocket-boosted vehicles of the same time period, with a further doubling available in second-generation designs.

In the advanced designs, the company says that specific impulses of the air-breathers would be even greater than that of nuclear rockets.

One step beyond Aerospace Plane is the orbital airplane, which can take station in orbit and then continue on a space mission. NULACE, Marquardt's approach to the nuclear rocket engine, is one step beyond the company's LACE concept, and is being studied as the powerplant for orbital airplanes.

Here again tremendous performance gains are claimed. Marquardt says: ". . . the performance of the combined engines is much greater than that of either engine alone. Uniquely, the performances of LACE and nuclear rocket are additive in this hybridization, almost without parallel in propulsion concepts. Specific impulses more than twice those of Rover are obtainable."

But there are side benefits for such a system beyond the performance gains:

- **Solving the problem** of nuclear radiation in the lower atmosphere. Marquardt studies show that NULACE, with higher specifics than Rover even without the reactor going, could boost a vehicle off the ground to a safe altitude for starting the nuclear cycle operation.
- **Air-breathing portion** can be separated by variable geometry so that the engine may be operated as a conventional nuclear rocket in space. This gives operational flexibility from the surface of the earth right up into and through space without the hazards of nuclear reactor operations near the ground.
- **NULACE reactor** size is several times smaller for an orbital airplane than for the Rover reactor required to deliver equal payloads into space.

Economic Analysis

Cost analysis made by the company indicate that both LACE and NULACE should achieve operating economies on the order of four to five times better than the best to be expected of conventional rocket systems. Marquardt figures show little hope of decreasing costs below about $100 to $200 per pound in orbit with chemical rocket systems.

One example cited is a moon base weighing 1,000 tons, which requires 2,000 tons of additional materiel to support its complement of 100 men over a ten-year period. Marquardt says that to transport this amount of payload only to an earth orbit would cost $72 billion at today's prices. Even if the most advanced boosters are considered, then the cost can be dropped to about one-tenth that figure, perhaps to $7 billion. This is a reasonable amount, but not if more than one space project is being conducted simultaneously. But specific cost calculations for moving this load into orbit by means of an aerospace plane concept show a figure of $1.7 billion.

Continuing Program

LACE and NULACE are two phases of a continuing program of study and development on airbreathing engines which has been funded at Marquardt by USAF since 1948. Last year the Air Force redirected Marquardt's effort in airbreathing powerplant work toward aerospace applications, and it was this redirection that provided much of the impetus behind the two new concepts.

There have been tangible benefits so far from the general program of airbreathing powerplant development, the company reports. The RJ43-11 ramjet powerplants for the Boeing IM-99B Bomarc were a direct outgrowth. So was the Hyperjet, a dual-cycle engine combining ramjet and rocket in a single combustion chamber, and originally logically considered as the next step in powerplants for the Bomarc.

Scout Probe Relayed Data From Ionosphere

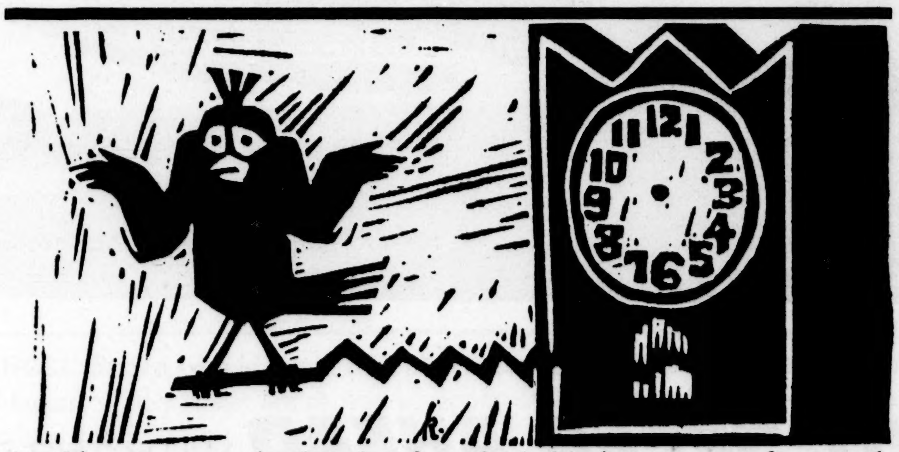
Washington—P-21 probe launched by the National Aeronautics and Space Administration from Wallops Island, Va., in the seventh Scout vehicle development flight resulted in approximately 30 min. of telemetry data on characteristics of the upper ionosphere.

The experiment, flown Oct. 19, was the third of four ionospheric sampling flights planned by NASA. Next flight will be made early next year as a Scout payload and will measure ionospheric characteristics at night. The 94-lb. P-21 was designed to obtain a daytime profile of the ionosphere.

The four-stage, solid propellant Scout carried the payload to a maximum altitude of 4,261 mi., and a range of 4,424 mi. Maximum velocity, reached at four-stage burnout, was 25,200 fps.

The flight was the second successful probe in the Scout development program, which is scheduled to end with the next launch. Previous probe was launched Oct. 4, 1960. Scout also has placed two satellites in orbit, the Explorer IX 12-ft. air density sphere launched Feb. 1, and the micrometeoroid impact Explorer XIII launched Aug. 25.

PROBLEMATICAL RECREATIONS 91



At this moment, the hands of a clock in the course of normal operation describe a time somewhere between 4:00 and 5:00 on a standard clock face. Within one hour or less, the hands will have exactly exchanged positions; what time is it now?

—Contributed

It's time we talked of the Maryland Division of Litton Systems, Inc. You know of their antenna and microwave systems. But did you know they are also very large on instrument landing systems, electronic countermeasures, telemetry systems, electronic position indicators, fire control systems, and radar and surveillance systems? Well they are. Inquire at: 4900 Calvert Road, College Park, Maryland.

ANSWER TO LAST WEEK'S PROBLEM: **The largest possible number is 3^{32}. 2^2.**

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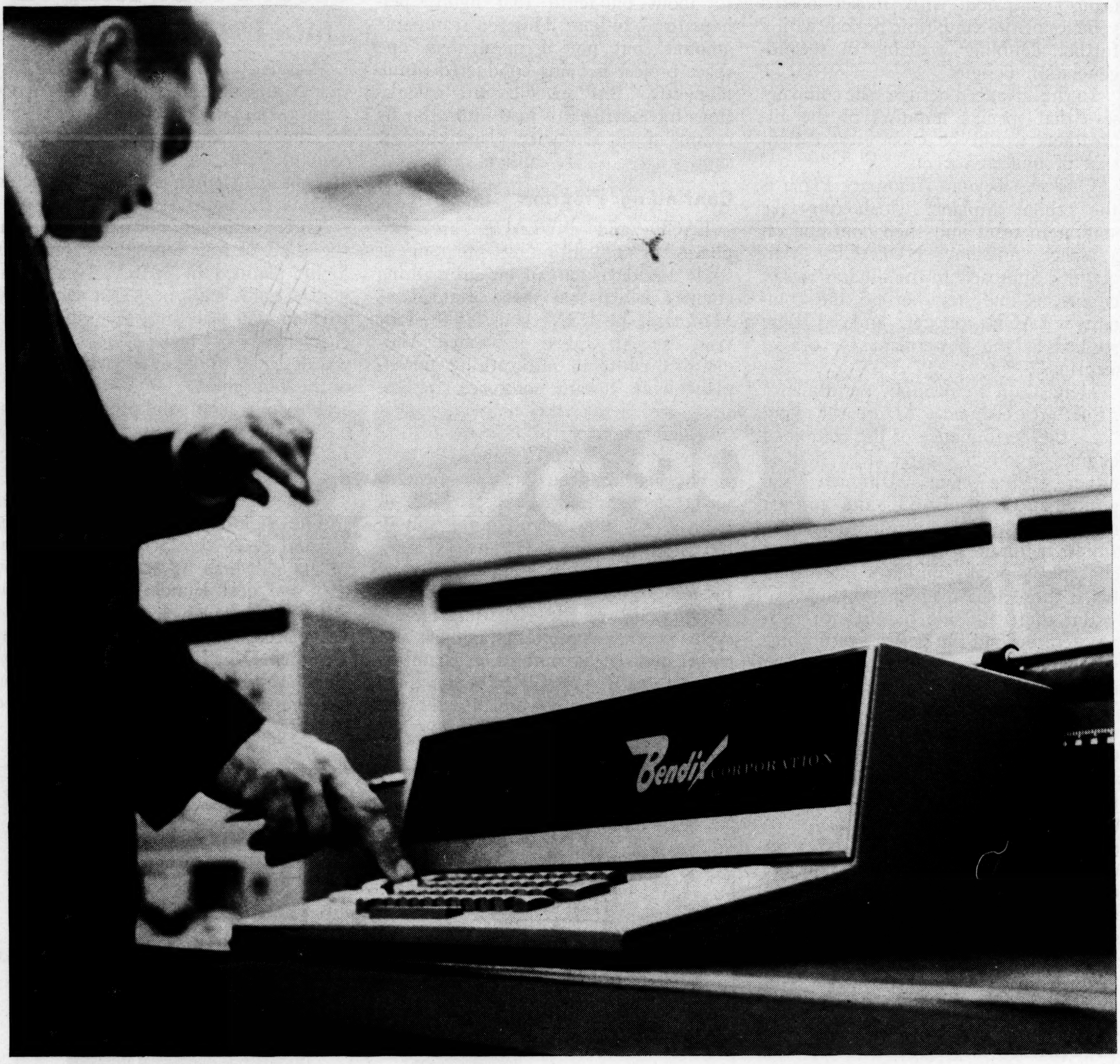

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THE Bendix CORPORATION

Short Brothers Planning Civil Freighter

By Herbert J. Coleman

Belfast—Short Brothers & Harland, builders of the massive Belfast turboprop cargo/passenger freighter for the Royal Air Force, will push the airplane in the world military and civil market as the logical long distance carrier, without undue emphasis on a pure-jet Belfast development.

Company philosophy is that the turboprop powerplants will be a dominant factor in the freighter's future, with speed considered secondary to the payload of up to 100,000 lb.

Still, Short Brothers is closely watching developments in planning and construction of the Lockheed C-141 turbofan freighter for U. S. strategic airlift (AW Oct. 9, p. 50) but the feeling is apparent that the large turboprop is a far more potent competitor in the operating cost parameters of the civil field.

The company's joint managing director, Hugh G. Conway, goes a bit further than that; he sees the Belfast as the eventual successor to the Douglas C-133 and stresses the fact that the British design can be offered in an STOL version, using packaged Rolls-Royce RB.108 pure lift engines. Another major point is the vast cargo hold, measuring 12 ft. x 12 ft. in cross-section with either aft or nose loading.

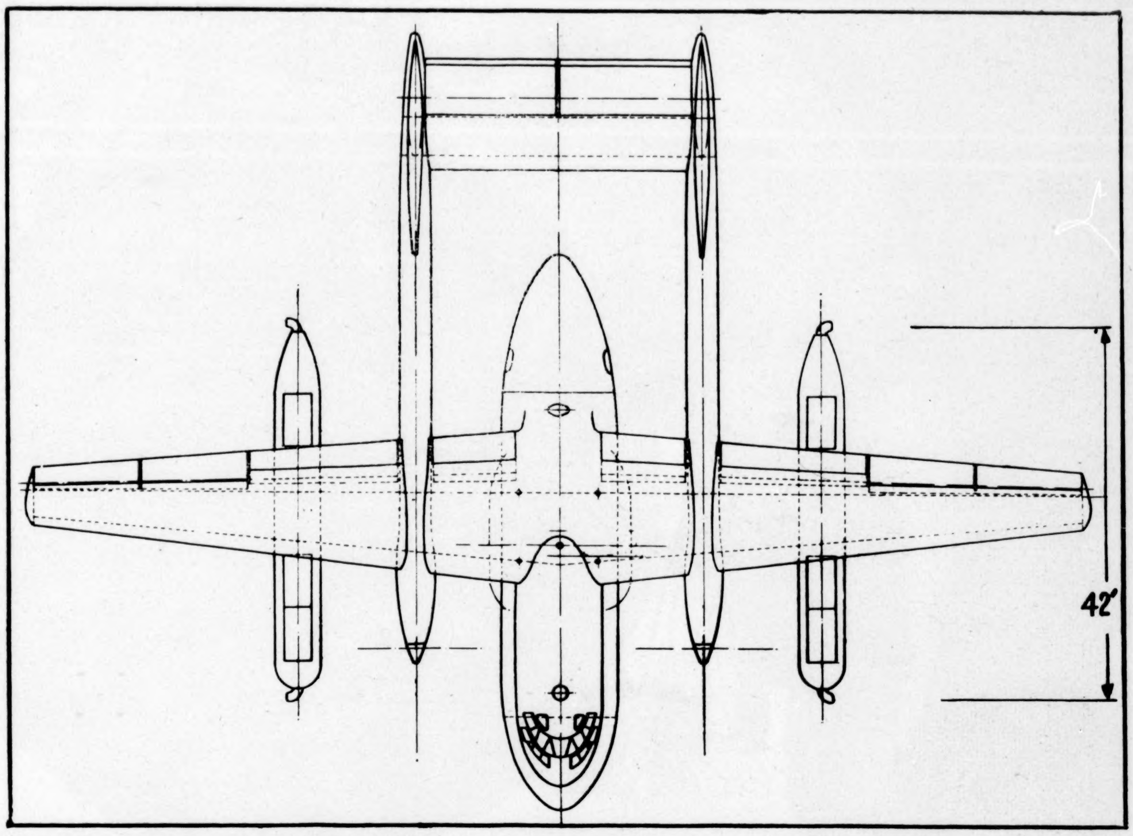
Civil Market

To crack the civil market, Short Brothers is expending considerable time and talent on working out the details of an integrated cargo system, from a unique double-floor design, to layout of an entire terminal facility.

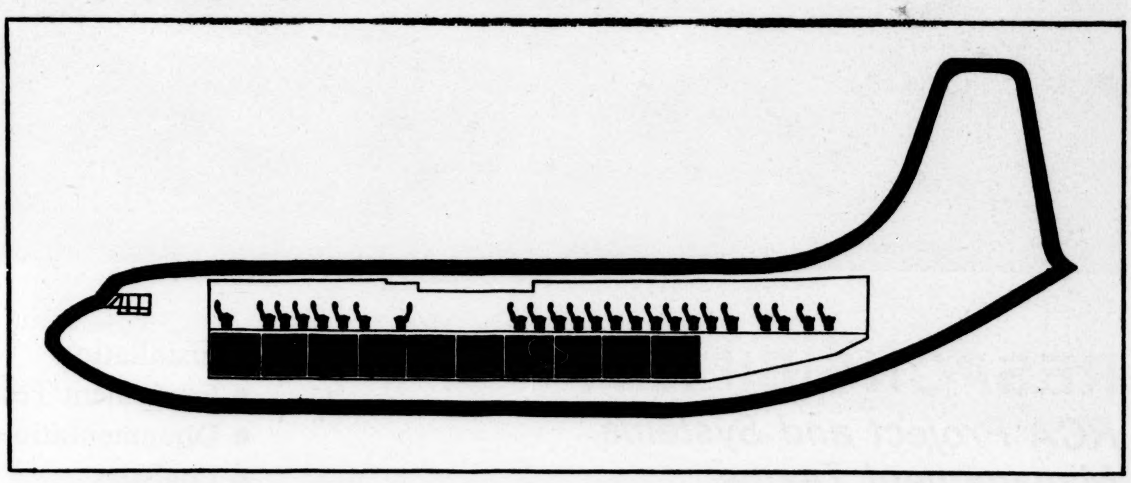
However, this increasing interest in the civil field is, of necessity, secondary to getting out the first 10 airplanes for the Royal Air Force, all of which will be aft-loaded. Because of its military application, timetables have been classified by the Air Ministry, but a source outside the company said the first Belfast could be rolled out early in 1963, on the basis of work now under way.

Right now, three nose sections are under construction, two of them well advanced. Center sections of two airplanes are in the jigs and panels are being cut. One delay occurred when heavy landing gear truck deliveries fell behind, after breakdown of a subcontractor's forging machine, but this has been rectified.

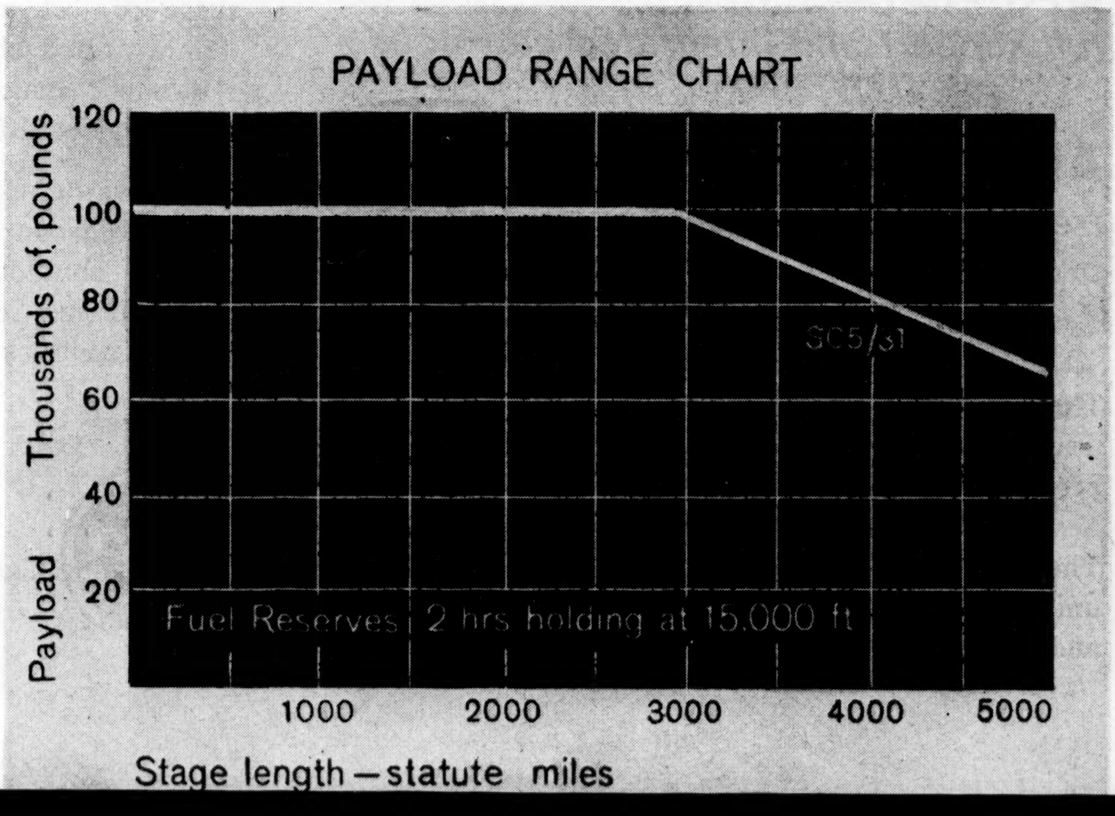
Production line for the 10 airplanes has been fairly well established, although

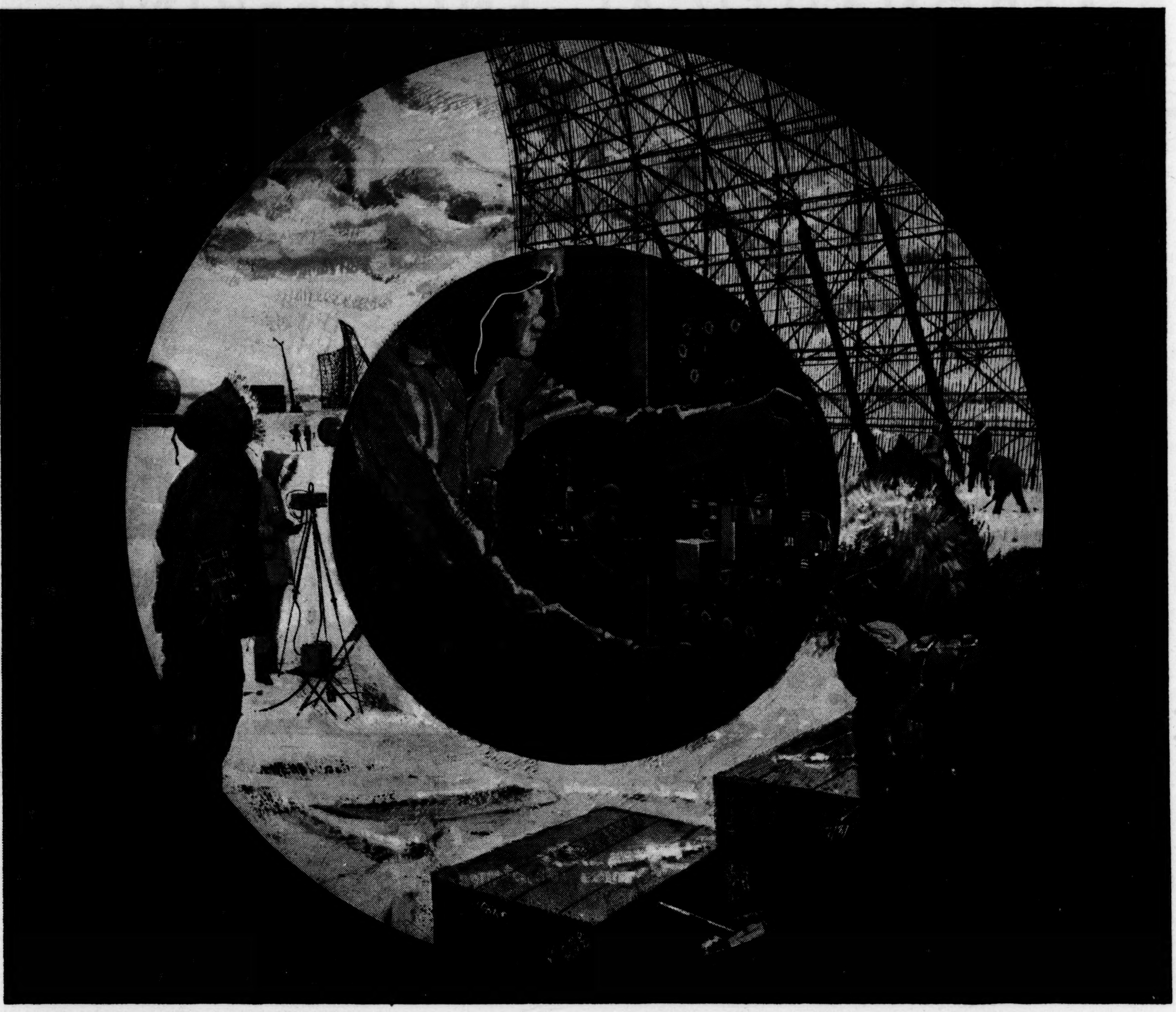


DESIGN envisioned by Short Brothers & Harland in 1955 would have allowed conversion of a twin-turboprop freighter into a tactical VTOL airplane by substituting lift engines in two pods hung on pylons, for two external fuel tanks.



SWING-NOSE Belfast would seat 141 passengers in three-abreast configuration, mostly rearward-facing. Entry doors are at rear of upper deck. Belfast is designed to carry 62,000 lb. of payload for 5,000 mi. (below).





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at present the last of the photographic reconnaissance Canberras built by Short Brothers is mixed among Belfast hardware. Wings are a modification of those of the Bristol Britannia—the Belfast originated as a larger version of that airplane—and will be built by Bristol Aircraft for shipment to Northern Ireland.

The airplane now being built is the SC.5/10, powered by four Rolls-Royce Tyne 12 turboprop engines, 5,730 ehp., with an 11,000 cu. ft. cargo hold volume. Payload capacity is 81,000 lb. over 950 stat. mi. at 340 mph.; for extremely long ranges, it can carry 20,000 lb. payload over 5,200 stat. mi. at 340 mph.

Variants of this version are:

- **SC.5/20 tactical freighter** powered by Tyne R.Ty. 22 (Stage 4) engines and 18 ft. propellers for improved takeoff performance. Airplane is identical with the 5/10 version although the ramp has been beefed up, along with the aft fuselage structure, for dropping supplies in excess of 35,000 lb. unit weight. The 5/20 is designed for a paratroop carrier role, using 60 canvas seats fitted to the side of the hold, and another 60 in the center. Jump doors would be 6 ft. 4 in. high and 3 ft. wide. Used as a troop transport, the Belfast 20 would carry 147 soldiers with seats at a 35 in. pitch. As an ambulance, it can be converted for 56 stretcher cases, 48 walking casualties and eight medical attendants.
- **SC.5/20 tanker,** in which four packaged units carrying up to 10,000 gal. would be supported on cradles in the center fuselage. Hose for in-flight refueling would be mounted in a special rear door.
- **SC.5/31,** the swing-nose version for civil uses (AW May 15, p. 47), a double-decker designed for London-New York-Canada air freight routes with a 100,000 lb. payload. In a combined cargo-passenger layout, it could haul 141 passengers on the top deck, and 60,000 lb. of palletized freight on the lower deck.

Final version, which Short Brothers will not discuss except in very general terms, is the Belfast with STOL capability and which has been submitted in the RAF tactical transport evaluation intended to replace the Blackburn Beverley now used (AW June 26, p. 32).

The STOL Belfast would utilize three RB.108s mounted in a hump on the upper center fuselage, but this design appears to have become secondary to two others, the Bristol 208 and Armstrong Whitworth 681 designs, both of which have Mk. 2 versions capable of 100% vertical takeoff (AW Sept. 18, p. 43).

Regardless of the final decision—and Conway is convinced that at present, the need for pure VTOL is conjectural

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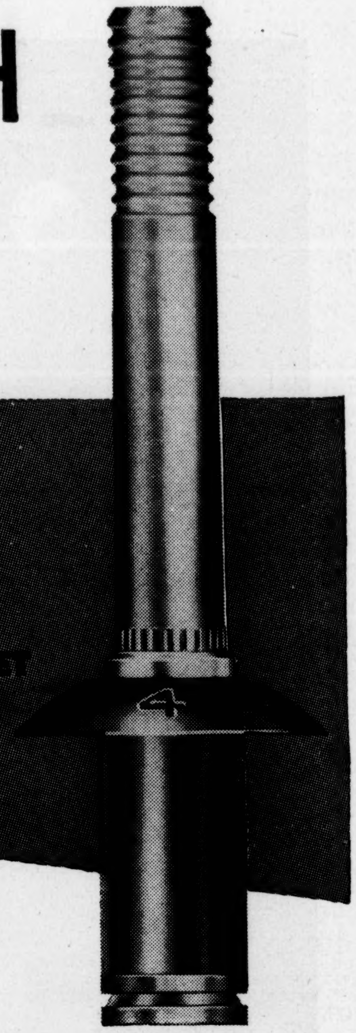

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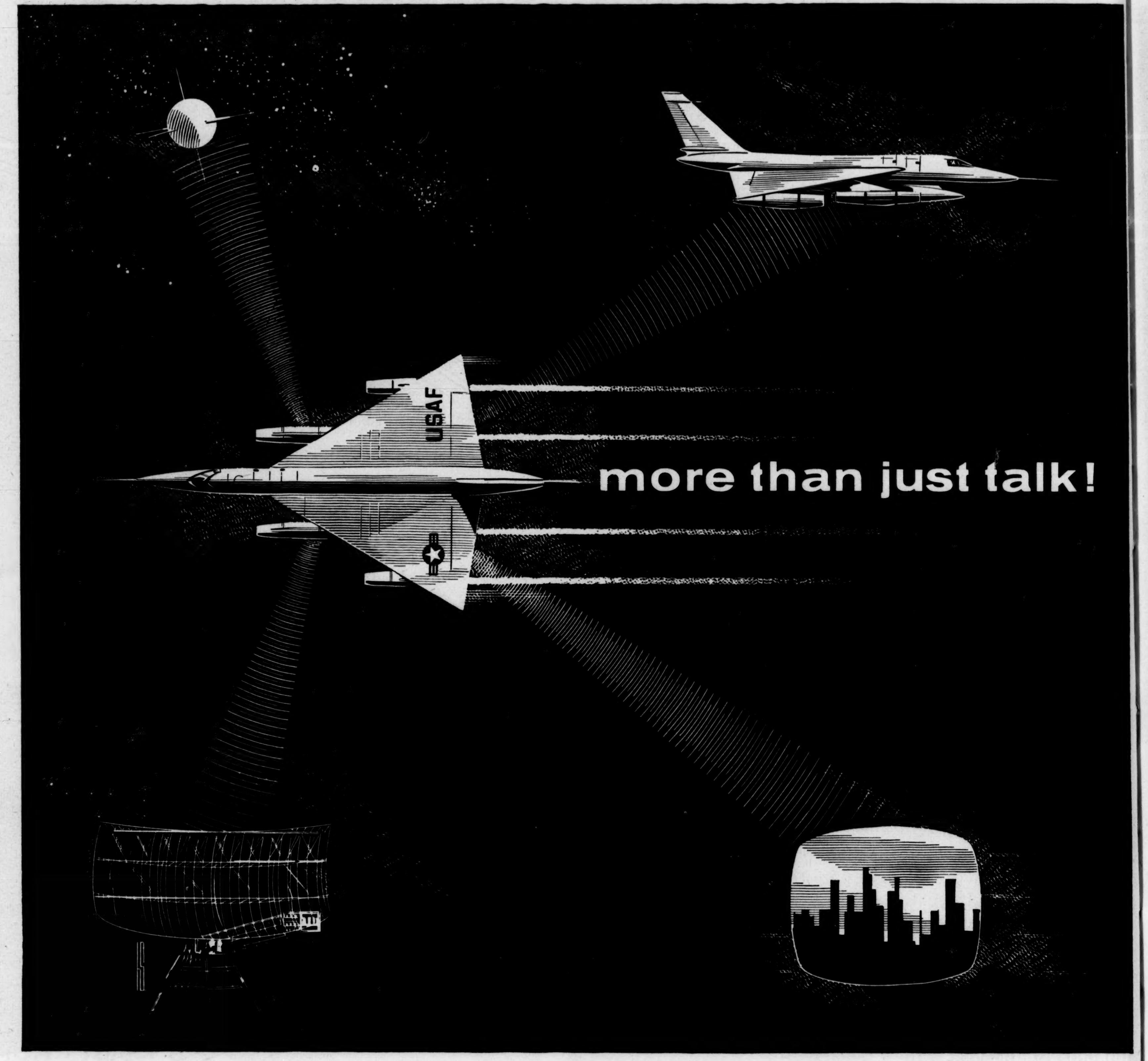

Magnavox continues to maintain a position of leadership in the airborne communications field.

Magnavox engineering, in conjunction with the Air Force, has developed an advanced airborne communication system that is designed to meet the requirements of the future. Utilizing wide band techniques, such functions as television relay for bomb damage assessment, data link for control and identification, and many other forms of air-to-air and air-to-ground communications can all be realized over the same equipment as used for voice.

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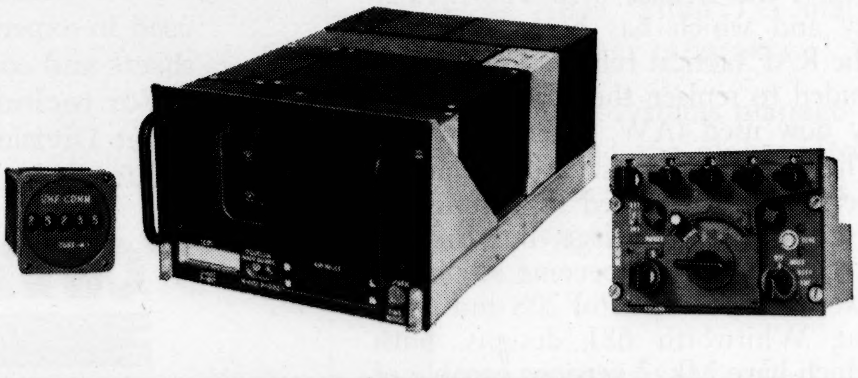

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THE MAGNAVOX CO. • DEPT. 416 • *Government and Industrial Division* **• FORT WAYNE, IND.**

—Short Brothers is pinning its hopes on cost of development of the STOL Belfast as against that of a completely new design, such as the two it is competing against.

The ever-present factor—and one by no means minuscule—is the political ramifications surrounding the entire project. Unofficially, the word is the award will go to the company most in need of military work, particularly in view of the fact that the Bristol and Armstrong Whitworth designs are almost identical. In these two cases, the companies involved are British Aircraft Corp. (Bristol) and Hawker Siddeley Group (Armstrong Whitworth).

Short Brothers, which currently has an employment roll of 10,000, has a more complex problem. The company is 90% owned by the British government, and in the past, the politicians have leaned toward awarding contracts to privately-owned firms to escape criticism of supernationalism, despite the validity of a Short design.

A case in point is a Short Brothers design for a tactical transport capable of vertical takeoff, submitted to the Ministry of Supply in 1955 and turned down on the grounds it was too advanced.

The design envisioned a twin-boom, twin-turboprop transport, which, in retrospect, generally resembled the Armstrong Whitworth Argosy, and which gained its vertical lift from RB.108s podded on either wing. Designated PD. 16 (for Product Design No. 16), it has been kept under wraps until now.

The firm told the Ministry that, based on experience gained in design and construction of its SC.1 VTOL research vehicle, the turboprop carrier could be transformed to a VTOL role at short notice; the jet lift pods would replace external fuel tanks.

The design envisioned, thusly, a number of short-range tactical transports available for military use, and with VTOL capabilities, without creation of a group of specialized, single-purpose aircraft. The pods, each holding 18 RB.108s arranged in three banks of six, would, in effect, be self-contained.

Control Nozzles

Forward and aft from the engine bays, outrigger structures would carry compressed air ducting to the control nozzles, to provide a total of four control-thrust points in a rectangle about the airplane's center of gravity.

As part of the self-containment aim, the pylon supporting the central pod structure would utilize the same wing fittings as the standard fuel tank pylon, with addition of a side-stay. Bulkheads and longitudinal webs surrounding the engines would be firewalls, to restrict fires to any two engines.

At the bulkhead positions, transverse members, together with four booms, would form open trusses in the lateral bending plane to allow top and bottom surfaces of the pod to be used as engine doors, tank and general access doors.

In this particular design, each group of six engines had a common fuel and oil system, throttle control, ignition system, starting air supply and control air system. Any two groups of the lift engines could have been started together by air bled from the main propulsion engines, in this case two Bristol Siddeley Proteus 755s, calling for about 11% of takeoff power mass flow.

For control purposes and for driving fuel pumps, compressor air would have been tapped from every lift engine into the main bleed belt, and control air ducted to the nozzles on the outrigger ahead and astern of each pod.

Control nozzles were designed to swivel in the transverse plane, either symmetrically or asymmetrically, according to whether roll or yaw was required. Pitch control was achieved by throttles in the control ducts upstream of each nozzle, which varied the distribution of air between forward and aft nozzles. Height control, of course, was obtained by total thrust variation, using lift engine throttles.

An auto-stabilization unit was mounted in the fuselage and operated on the nozzle controls alone for both roll and pitch. It did not have any effect on aerodynamic control surfaces. Control stick was not directly connected to the nozzles, but simply monitored the auto-stabilizer. Yaw control was provided by direct connection of the nozzles to the rudder pedals.

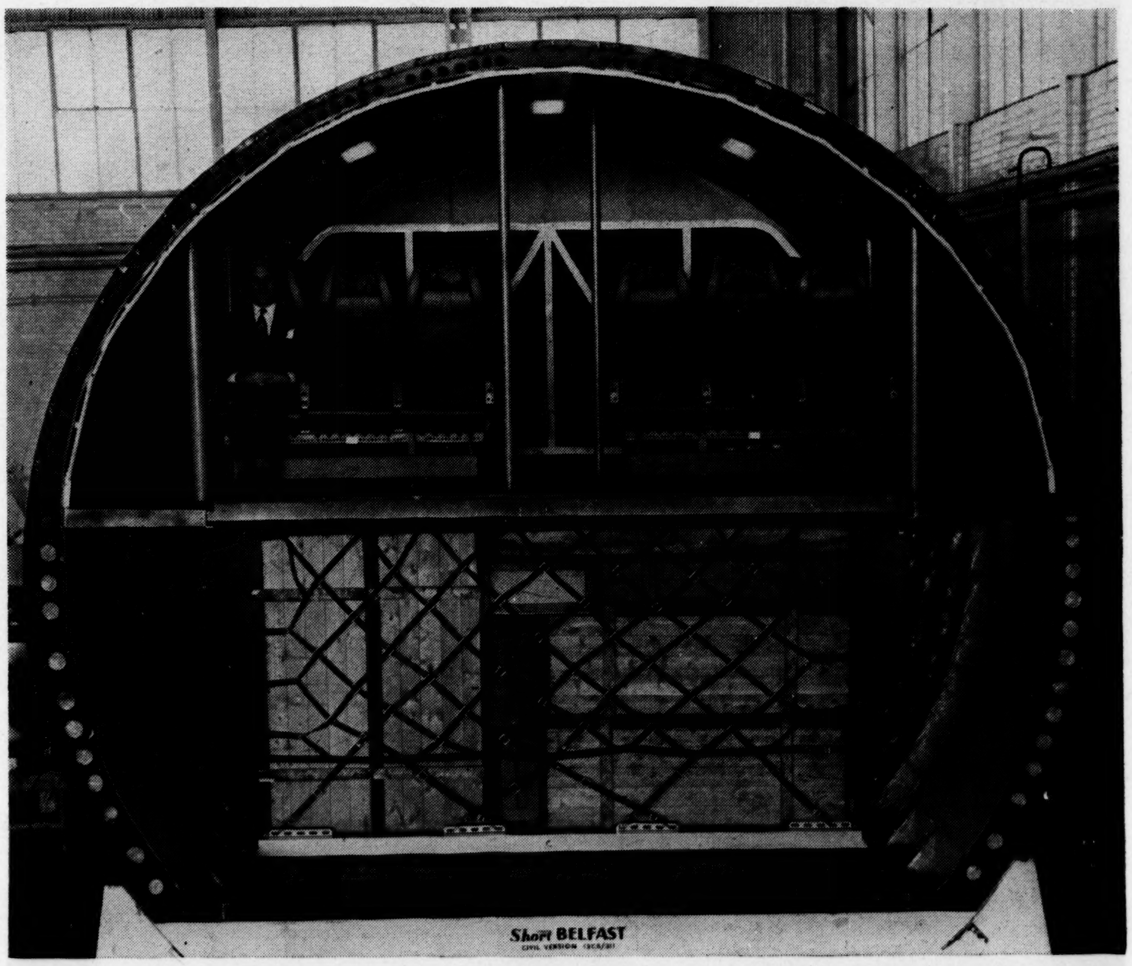
To modify the PD.16 into a VTOL transport, from a basic weight of 40,955 lb. without the tank pylons, Short Brothers would have added another 17,095 lb., of which 330 lb. would have been wing beef-up, 8,640 lb. for 36 lift engines, another 5,252 lb. for structure, bleed belt and nozzles, and the remainder for controls, hydraulics, fuel system, etc., for a new gross weight of 58,050.

Operational Weight

Thus, operational weight, considering crew and loading ramps, would become 58,790 lb. and, adding 16,210 lb. for payload and fuel, maximum takeoff weight would have been 75,000 lb. Used as a VTOL, specific range would have been reduced about 3% from the standard aircraft. Time from liftoff to forward transition at 100 ft. would have been 80 sec.

A VTOL design, corresponding roughly to this one was at one time considered by Armstrong Whitworth, but it later was canceled in favor of placing more stress on use of Bristol Siddeley BS.53 engines with deflecting nozzles, plus wing tip pure-lift engines.

Short Brothers by no means has dropped its interest in podded groups of lift engines. The company has been approached by a number of aviation firms in other countries (at least one from the U. S.) and has been cooperat-



MOCKUP of swing-nose version of the Short Belfast shows seats mounted in units, with flooring and seats attached and mounted in runners which traverse the fuselage sides, supported by heavy posts. Lighter posts help secure the seats (staggered at center section).

groundbreaking

▸▸ Some day — not far away in time — earthbound intelligence will set up base on the moon.

▸▸ First, perhaps, the robot explorer, such as the "Moonmobile," designed and developed by Space-General Corporation, answering many of man's questions about his celestial neighbor. Ultimately — groundbreaking — and the return to earth of the first substance from a foreign planet.

▸▸ Soft lunar landings have been studied in depth by Space-General Corporation, America's uniquely capable source for space systems. Space-General's management and staff have been part of this nation's ICBM, IRBM and space programs since the earliest days. Familiar accomplishments include the reliable Ablestar space engine. Others are in the making — advanced launching vehicles, commercial and navigational satellites, space-based weapon systems and nuclear-powered space vehicles.

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ing with designers of V/STOL projects, Fiat for one, primarily in the control regimes.

The company also is continuing its research in SC.1 flights, particularly in instrumentation and blind landing techniques (AW Oct. 23, p. 79).

In a less spectacular area, Short Brothers is pressing its business flying activities (company is a Beechcraft distributor and a team currently is surveying African interest), primarily in completion of the first SC.7 Skyvan light transport.

Skyvan Development

A Skyvan team of 25 men, headed by Frank Robertson, has the airplane on schedule for its first flight early next year; the complete fuselage is taking shape and work is under way on first wing sections for Skyvan I. Skyvan II is the turbine-powered version (AW Oct. 9, p. 103).

In addition, Continental is preparing to ship the first two 390-hp. GTSIO-520 piston engines, which drive 8-ft. Hartzell propellers. Skyvan II, on which work will start next year, is a military version using two 550-ehp. Turbomeca Astazou turboprops turning 8-ft. Ratier-Figeac propellers.

Company faith in the future of the Skyvan is reflected by Conway, who said he would build 10 airplanes immediately, if the funds were available. Interest has been shown by operators in Australia, Africa and Alaska (Wien Alaska executives have twice visited the plant to check on progress).

No beauty, the Skyvan is a rugged, slab-sided airplane designed fail-safe for tough operating conditions. Non-buckling stressed skin structure makes extensive use of Redux, with panels bonded in large units; wing skin, for example, is a single unit from root to tip.

Payload of 3,000 lb. is carried in a hold measuring 16 ft. x 6.5 ft. x 6.5 ft. Instead of cargo, 15 passengers can be seated, if desired. Dual controls will be offered only as an optional item. Current design also includes two small side doors which will be used primarily for access to lashing points in case of tight loads.

SC.5/31 Specifications

Span	159 ft.
Length	136 ft. 6 in.
Height	47 ft.
Cargo volume	11,000 cu. ft.
Fuselage diameter	17 ft. 7 in.
Wing area	2,466 sq. ft.
Gross weight	294,000 lb.
Capacity payload	100,000 lb.
Fuel capacity	96,000 gal.
Range, 80,000-lb. payload	4,150 stat. mi.

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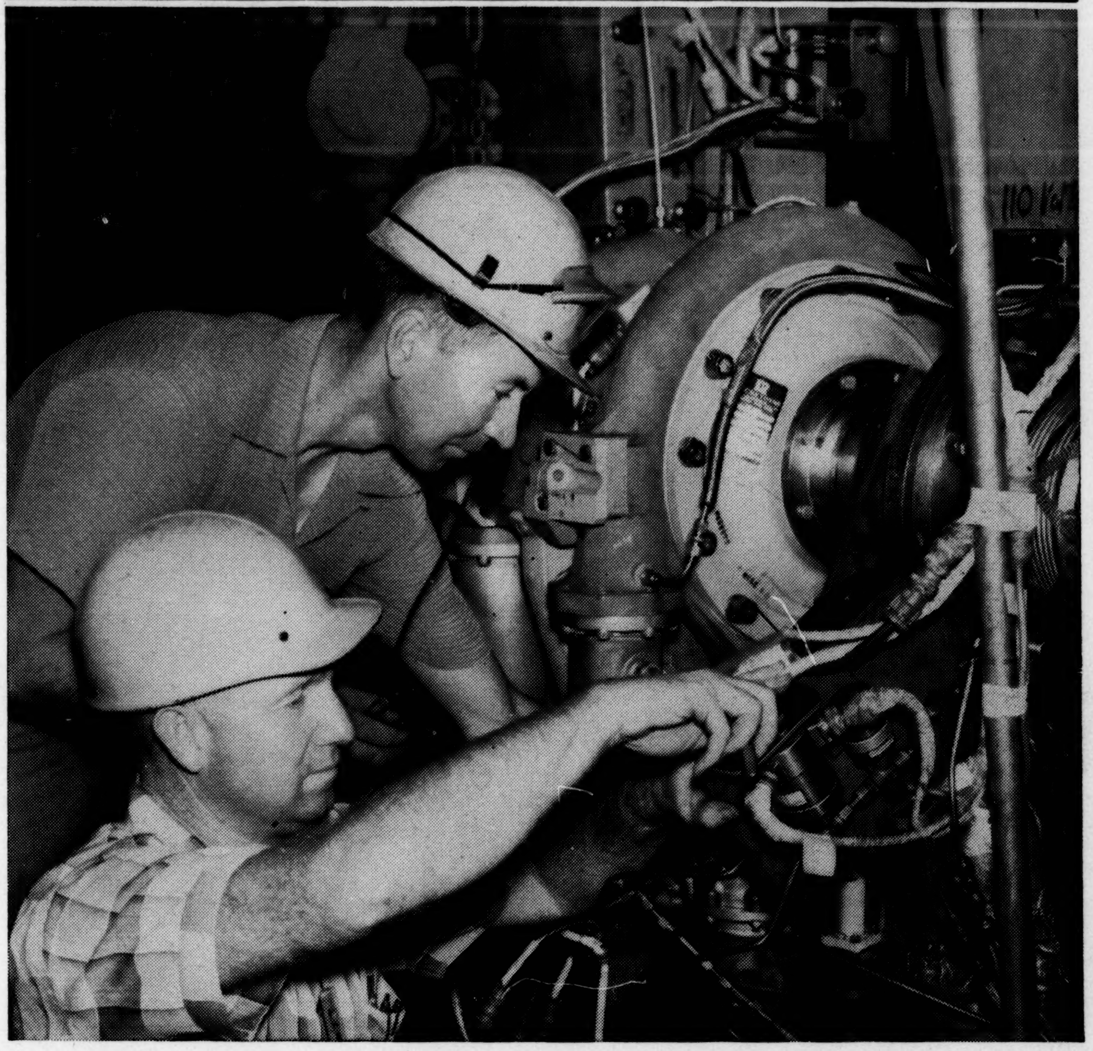

Taber Transducer checks LOX injector pressure on Atlas engine at Rocketdyne

Hot firing of all engines to make sure they're up to Air Force specifications is standard procedure at Rocketdyne, a division of North American Aviation, Inc. As this Atlas Booster engine is readied for testing, attention focuses on the Taber Bonded Strain Gage Pressure Transducer used to measure gas generator LOX injector pressure.

Taber Transducers are ideally suited for checking pressures such as this, as well as for numerous other laboratory, industrial, ground support and airborne applications. A wide variety of models is available in pressure ranges from 0-50 to 0-10,000 psi. Among the many features which contribute to rugged, dependable performance are: high frequency response, minimum hysteresis, infinite resolution and low sensitivity to temperature effects, vibration and shock.

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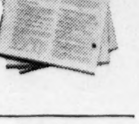

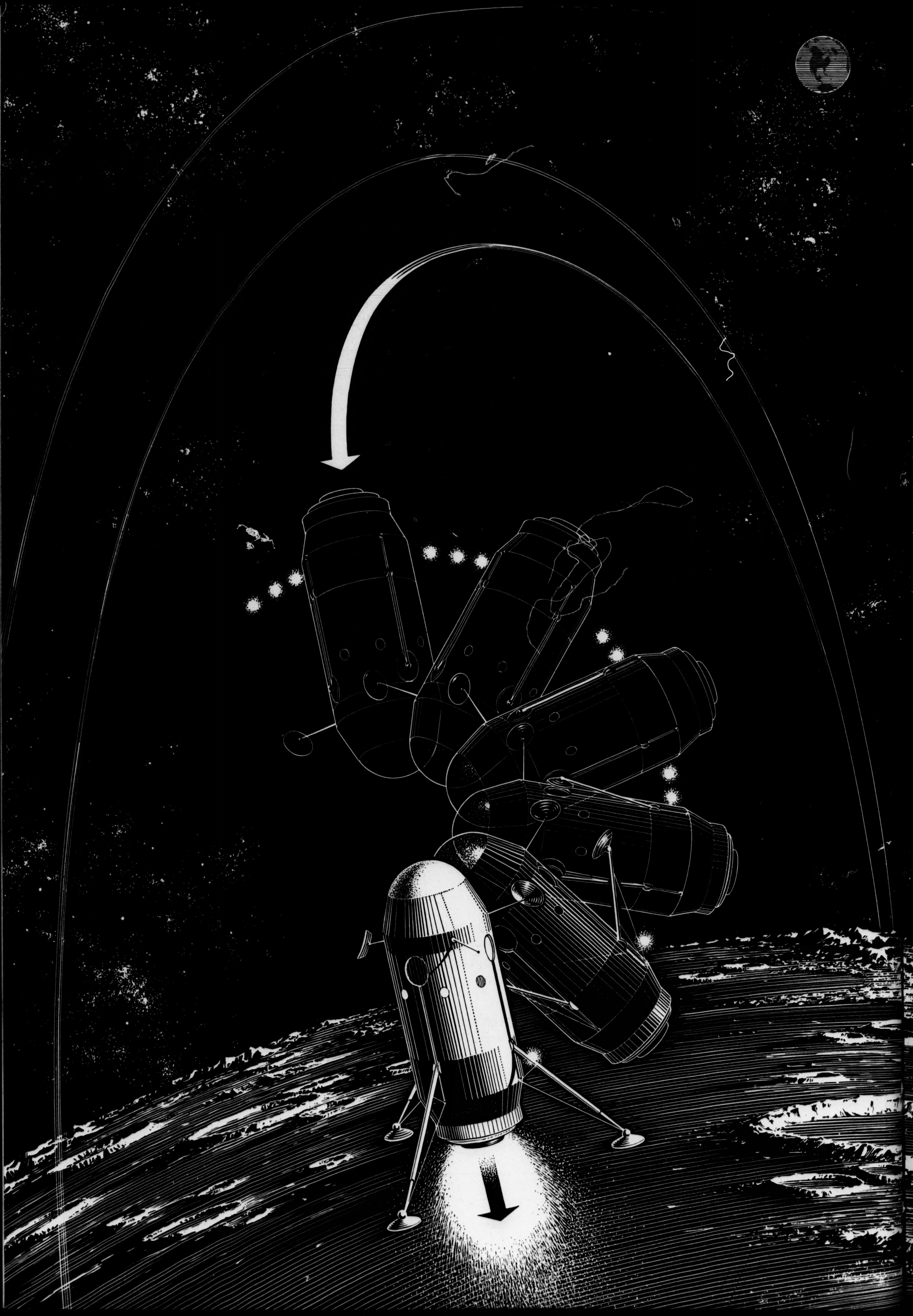

A New Achievement in Precision Controls for Space Application

Marquardt Documents 1,000,000th Pulse of Radiation Cooled Bipropellant Rockets

A three year research and development program directed at advanced space propulsion and control systems reached a significant milepost on September 8 when The Marquardt Corporation documented the 1,000,000th re-start of radiation cooled bipropellant pulse rockets. These rockets, operating at pulse frequencies up to 100 cycles per second, demonstrated that combined response and delay times of .006 second and effective pulse widths of .003 second are now attainable. Development to reduce these times is currently in progress.

Typical of Marquardt's pulse rocket development in the range of 0.2 to 100 lbs. thrust is a 25 lb. thrust rocket for a current satellite propulsion requirement. *This engine demorstrated an intermittent operational life of over 50 minutes at rated thrust, and has achieved a remarkable 46 minute continuous run.* At the end of the test, there was no evidence of system deterioration. This type of rocket engine has repeatedly demonstrated a space Isp of 310 seconds using hydrazine and nitrogen tetroxide as propellants.

Coupled with Marquardt's secondary injection, gimballing techniques, and throttleable rockets, these pulse rockets make possible a range of control systems that can meet the most advanced space control requirements. In a complex lunar landing-return mission, a Marquardt system can provide main course velocity control, orbital ejection-injection, descent-ascent control, and lunar circumnavigation.

Marquardt's sixteen years of research and development in controls have led the company into many pioneering areas in the aerospace field. In variable thrust engines, Marquardt rockets, using storable liquid propellants, proved an average C* efficiency of 95% over a wide throttling range. Successful investigations and developments have been achieved in injectants for thrust vector control, including tap-off of hot gases from the primary combustion chamber, cold gases such as nitrogen or air, non-reacting liquids such as freon and reacting liquids such as hydrazine.

The Marquardt Corporation today provides the aerospace industry with one of the most extensively documented records in the area of space propulsion controls systems and components. Be it part or package, Marquardt can prove a record of performance which insures reliable products delivered on time and at minimum cost. For additional information contact R. L. Oblinger, Chief Application Engineer, Power Systems Division.

Engineers experienced in these or related fields will find it rewarding to discuss career futures with Marquardt—an equal opportunity employer.

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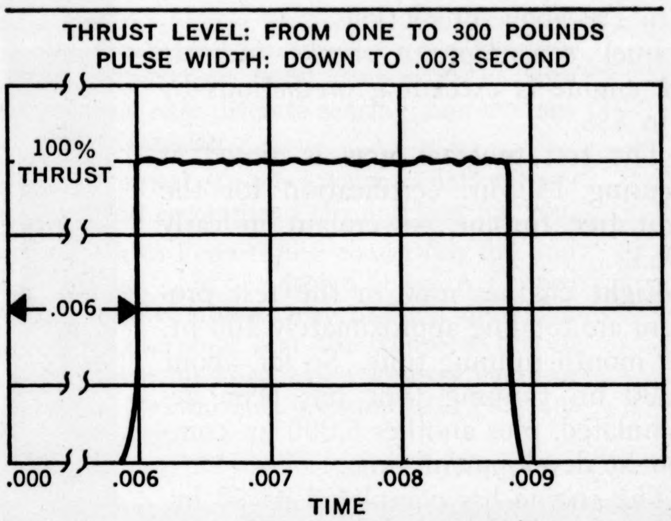
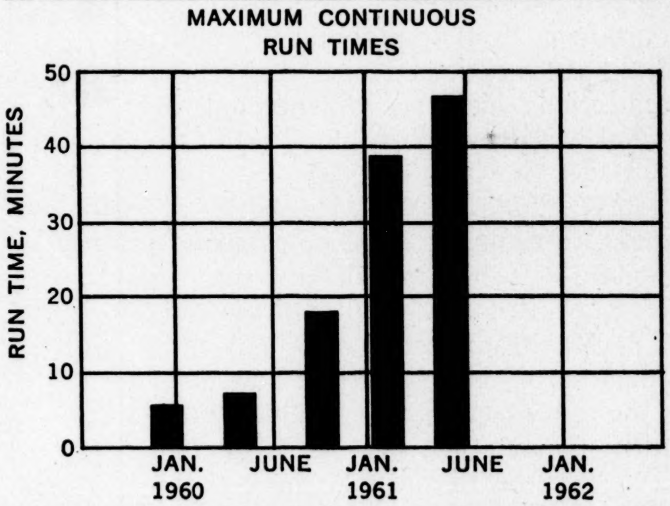


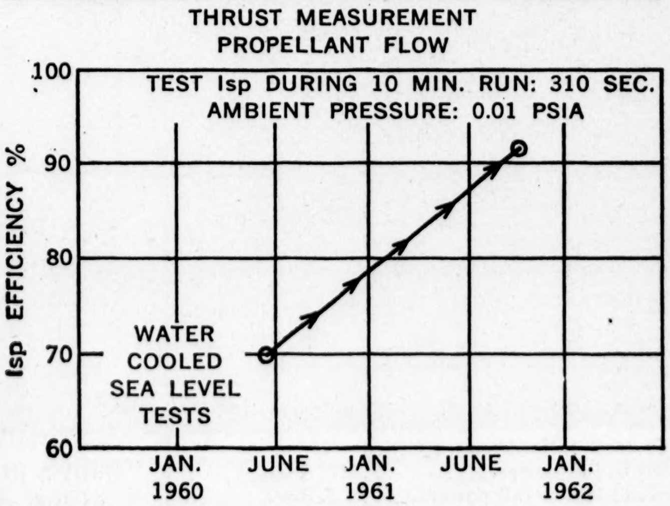
DOCUMENTED IMPULSE CAPABILITY

The above trace represents one impulse bit—demonstrating controllability of pulse width down to .003 second.



RADIATION COOLED THRUST CHAMBER RUN

Continuous 46 minute run duration of radiation cooled thrust chamber with N_2H_4 and N_2O_4 demonstrated a 90% efficiency with no degradation in performance during run and showed no adverse effects on the system.



DEMONSTRATED Isp EFFICIENCY

This chart shows thrust efficiency increase over slightly more than two years. Latest tests prove an Isp of 310 seconds, during a ten minute run at 0.01 PSIA.

PT6 Exceeds Its Estimated Performance

Canadian Pratt & Whitney Aircraft Co.'s PT6 (YT-74) turboprop/turboshaft engine has been checked against estimated performance curves to 25,000 ft. altitude during 20 hr. of flight test while mounted in the nose of a Beech 18.

Engine performance at altitude was 1 to 2% above predictions.

Fuel consumption checks indicate the engine is exceeding predictions by 3 to 5%.

The test program now is aimed at securing 150 hr. certification for the light free turbine powerplant in early 1963.

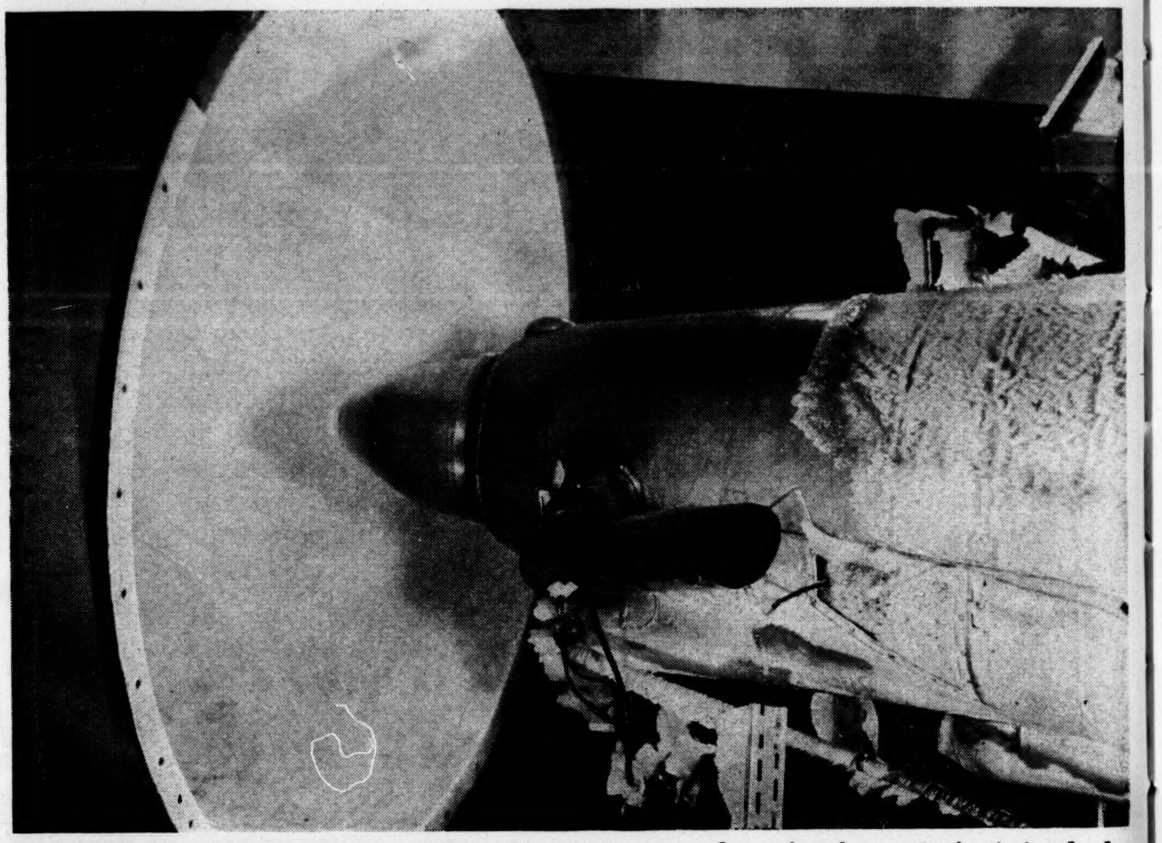
Eight engines now in the test program are totaling approximately 200 hr. per month running time. So far, about 2,300 hr. running time has been accumulated, plus another 6,000 hr. component development time.

The engine has completed its 50 hr. preliminary flight rating to U. S. Navy Bureau of Weapons standards (AW Apr. 3, p. 35). Engine components were reassembled after the inspection breakdown which followed the test and were run another 150 hr. successfully.

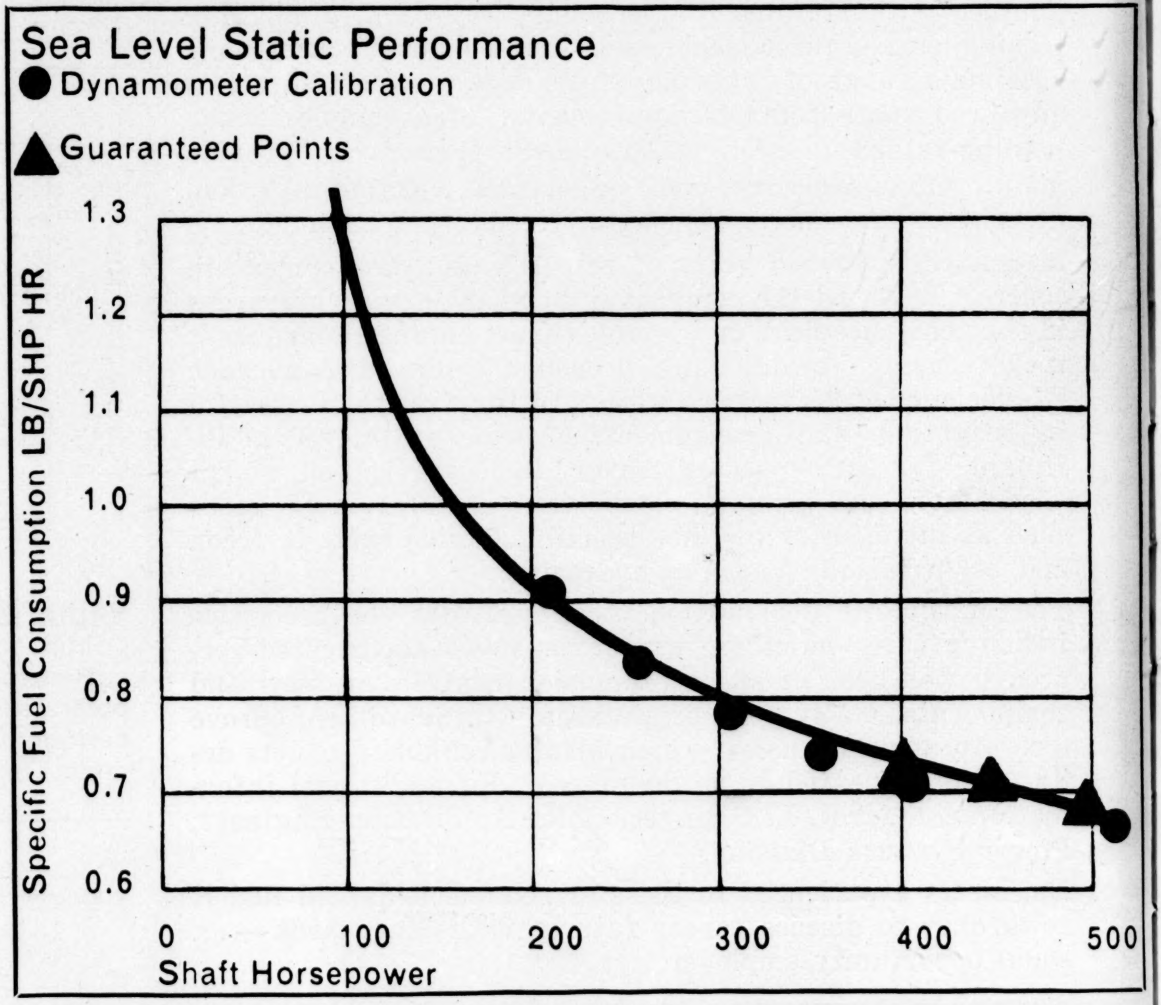
Anti-icing tests performed to both military and Federal Aviation Agency specifications have been completed at the National Research Council facilities in Ottawa.

Tests established the feasibility of using a three-nozzle, anti-icing alcohol spray on the turbine air inlet and screen. The spray used 2.5 gal./hr. of alcohol and prevented ice accretion to FAA and military specifications. Water flow during the test was 1.98 grams/cubic meter and the temperature was −6.5C.

Two versions of the PT6 have been developed—the PT6A series turboprop engine with a two-stage planetary reduction gear for propeller applications and the 6B series turboshaft engine with a single planetary stage reduction gear for helicopter and V/STOL applications. The A series engines weigh 250 lb., 25 lb. more than the B series engines.



PT6 TEST DEMONSTRATES feasibility of anti-icing procedures for the engine's air intake by using an alcohol spray (top). Sea level static performance is shown in graph below.



PT6 Sea Level Static Ratings

(as of September, 1961)

PT6A-2	eshp.	rpm.	Max. esfc. (lb./eshp./hr.)
Takeoff	500	2,200	.69
Max. continuous	450	2,200	.71
Normal rated	400	2,180	.73

PT6B-2	shp.	rpm.	Max. sfc. (lb./shp./hr.)
Takeoff	500	6,230	.70
Max. continuous	450	6,230	.72
Normal rated	400	6,230	.74

PT6 acceleration characteristics

Start to full power	17.8 sec.
Ground idle to full power	3.8 sec.
Flight idle to full power	2.5 sec.
85% power to full power	less than .5 sec.

Military specification acceleration is 5 sec. from flight idle to 95% power.

The PT6 was designed primarily for helicopter and light twin use. Application in V/STOL aircraft remains a secondary aim, according to the company's present thinking.

One of the test engines now is at Hiller for test flying in helicopter models and Beech is understood to be interested in possible light twin applications. Canadian Pratt & Whitney engineers say the engine could replace present 350-hp. reciprocating engines.

The PT6A-2 and B-2 versions currently are rated at 500 eshp. and 500 shp. respectively by civil standards and at 450 eshp. and 450 shp. by military standards. Both versions have a growth potential of about 100 eshp./shp.

The engine has a three point mounting system with all three points in the same plane for conventional aircraft.

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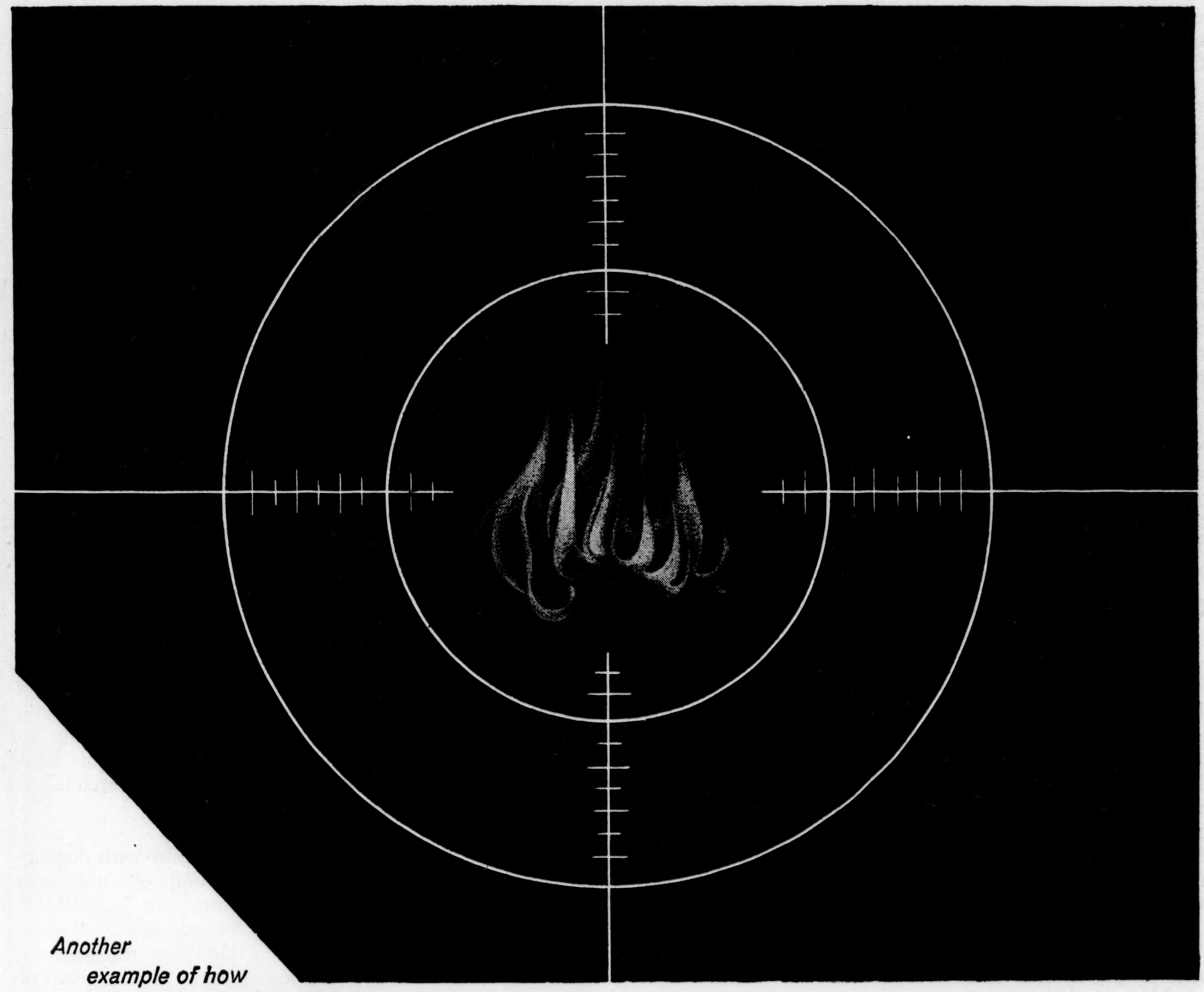
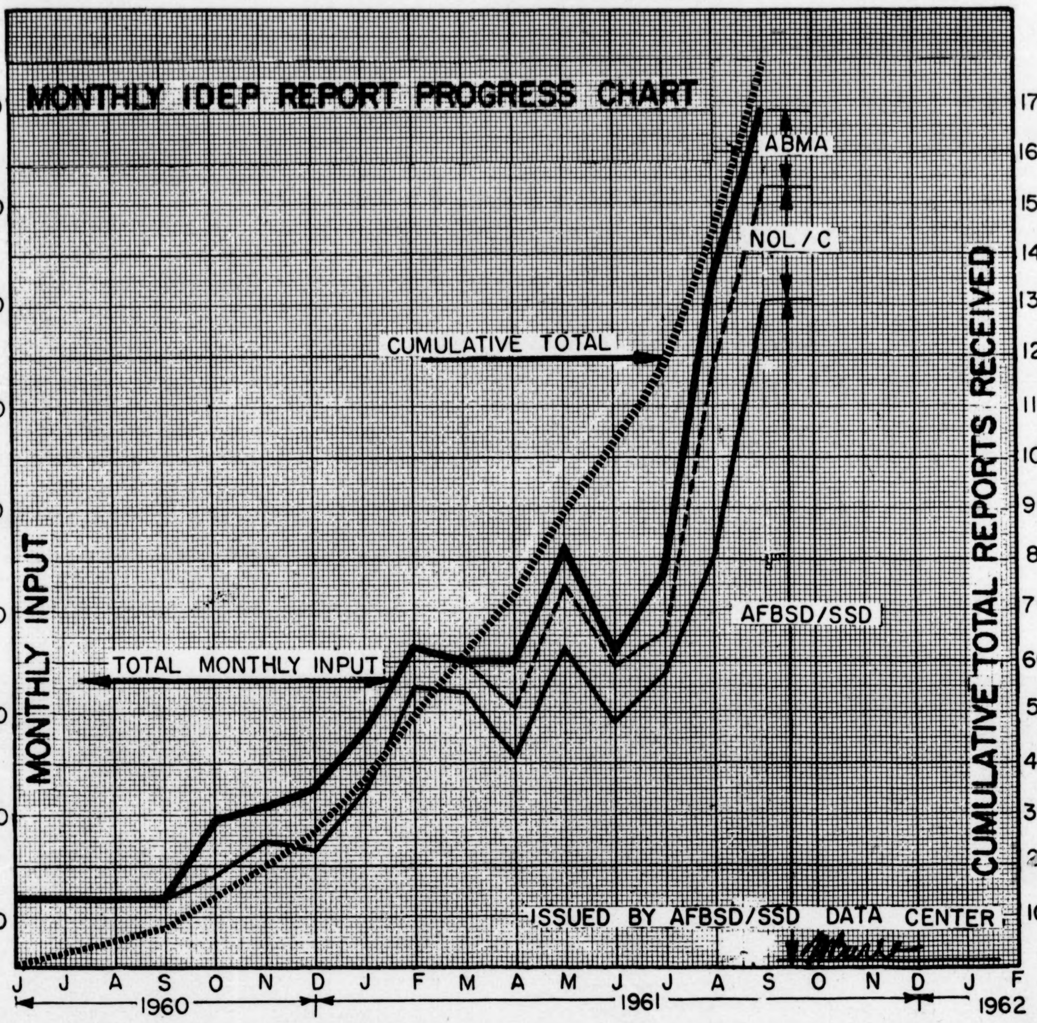


Another example of how

Fenwal DETECTS TEMPERATURE . . . PRECISELY

Data Exchange Program Yields Results

By Barry Miller



INTERSERVICE DATA EXCHANGE PROGRAM progress chart indicates rise in the number of reliability reports circulated among over 80 ballistic missile and space contractors (cross hatched line read on the right ordinate shows number of reports as a function of date) and number of reports fed into the program monthly (heavy black line with its scale at left ordinate). Individual service contractor monthly contributions are superimposed.

El Segundo, Calif.—Interservice Data Exchange Program (IDEP), a three-service effort to eliminate unnecessary duplication in component part testing by exchanging reliability data among ballistic missile and space projects contractors is beginning to yield tangible time and cost savings for many of its 85 or more participating organizations.

At the same time, the number of reports being exchanged in the program each month, the number of its participants and the services provided by the program are growing too. In addition, many IDEP procedures are being adopted in industry as a step to speed in-house or interplant test control and information distribution, according to Martin Barbe, who coordinates the program here at Aerospace Corp.

In the IDEP program (AW Jan. 25, 1960, p. 67; Feb. 13, 1961, p. 79), participating companies submit copies of test reports on component parts to one of three respective service data centers (the Air Force Ballistic Systems Division/Space Systems Division, the Army Ballistic Missile Agency or the Naval Ordnance Laboratory/Corona). The reports, covering component parts—ranging from individual components to larger purchasable parts such as potted circuits—are summarized on cards. Highlights of results along with test conditions are given. Microfilm strips of the original report are attached to the summary card. The data centers then interchange master copies and each center distributes to its contractors copies of the summary card.

Collate Specific Cases

To find and collate specific cases in which IDEP helped its participants, Barbe recently conducted a three-day telephone canvass of about 20 of the more active contractors handled by the Air Force. Eighteen specific incidents cited by people coordinating the program at these participating companies account for $150,000 in savings. Barbe figures his canvass covered only a third of the active recipients of IDEP reports and that specific quantitative values were assigned to only about a third of the reported incidents. He also believes the specific cases account for roughly half of the actual cases at each organization since the search for specific incidents was a cursory one. Extrapolating from these figures and assumptions, Barbe estimates the program has saved its participants about $2,700,000.

The mean available number of reports during the year preceding the telephone canvass was about 470 and less than half of the participating contractors were set up to effectively use the reports. In the future, both the mean number of circulating reports and the number of companies using them will rise. Between August, 1962 and August, 1963 a plateau of 5,000 reports in IDEP circulation is expected to be reached based on the present rate of transmission of reports into the program. This would mean that the present savings estimate is based on only $\frac{1}{10}$ of the potential available reports in circulation when the program hits full swing. The number of reports will stabilize at about 5,000 as the older, dated reports are removed from circulation.

By the end of this past September, slightly less than 1,800 reports were available in IDEP. The rate at which they were being submitted to the program rose to 340 a month in September. At this rate, Barbe estimates, the total IDEP report bank may rise to 4,000 to 5,000.

IDEP is expanding in several ways. It is now interchanging data with the Navy Guided Missile Data Exchange Program, supplementing data it previously obtained from Polaris contractors. In addition, the Army Ballistic Missile Agency is now handling Army Rocket and Guided Missile Agency contractors. Several National Aeronautics and Space Administration facilities recently began participating and within the Air Force there is a working arrangement to handle some of Electronic Systems Division's contractors.

Avoid Duplication

In an effort to do away with duplication in the planning of new tests among contractors, a pre-IDEP (PIDEP) program, recently was initiated. Under PIDEP, contractors submit into the exchange program plans of forthcoming tests and those under way. This gives other program participants an opportunity to cancel or modify their own tests if they learn other companies are conducting similar tests. It may also

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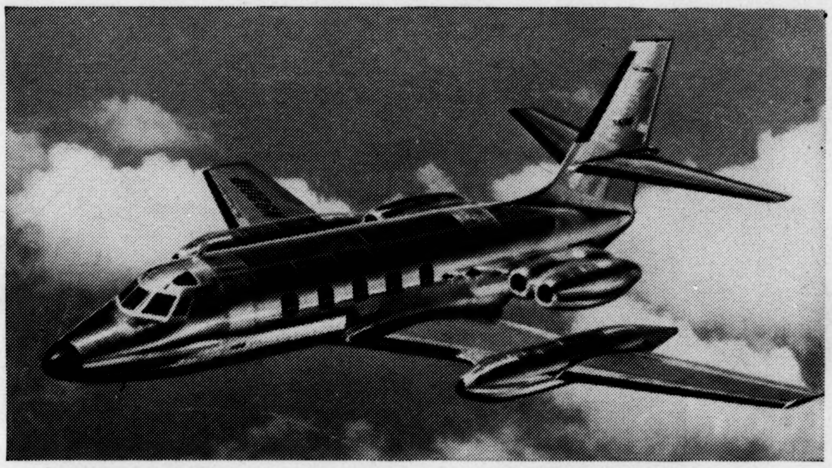

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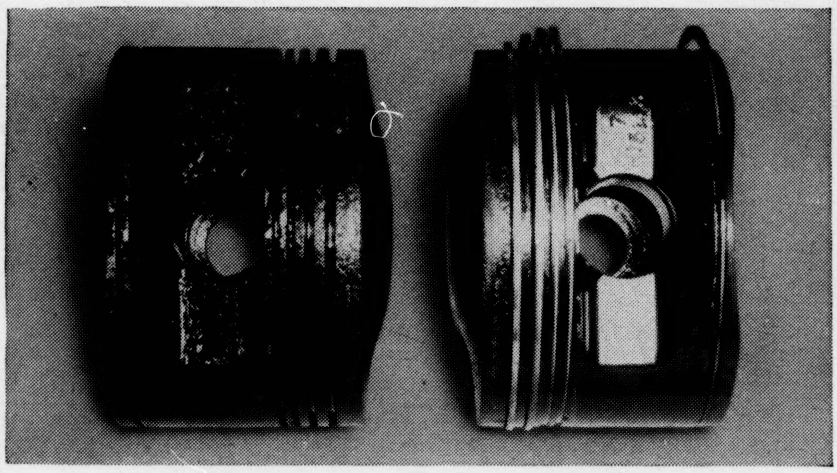

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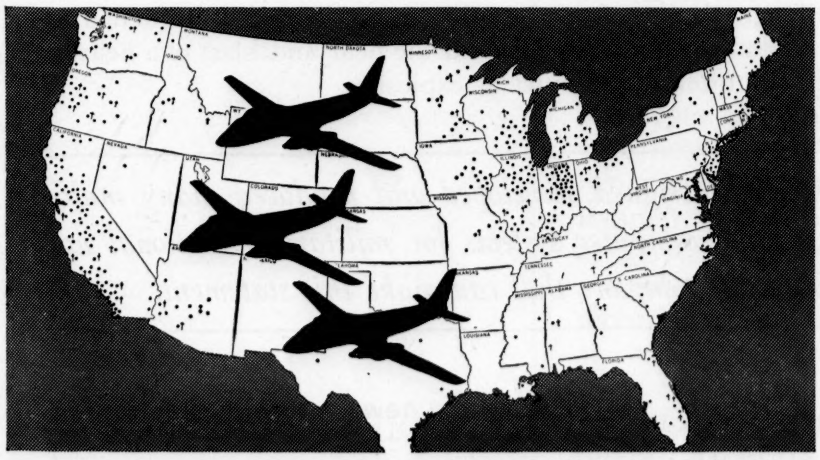

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enable contracting officers to improve individual test plans. PIDEP is expected to close the gap between the generation of a test requirement and the distribution to, and ability of, program members to use a contractor's test results.

Previously, IDEP handled only specific pieces of hardware, predominantly avionic components or parts, but it is now starting to include other types of reports. Among these are general process reports and others covering behavior of materials in a vacuum, welding of components and radiation effects on components and materials. IDEP also is attempting to facilitate future coordination of high reliability specifications to minimize duplication in this area. It would circulate corporate high reliability specifications after they have been coordinated with the vendor. Eventually these are to be coordinated by a DOD-Darnell type activity.

Some Overlap

In one space program, 90 specifications are planned while in another known case 37 specs were generated. Between these two there may be some overlap, and certainly some in format and test philosophy even if components and conditions differ. By interchanging specifications, overlapping can be avoided. In such exchanges, IDEP is not attempting to usurp the authority of a Department of Defense authorized group implementing the Darnell proposal, but rather is trying to assist in the interim period.

A further indication of the growing acceptance of IDEP, its principles and mechanics is reflected in their adoption by several companies for in-house procedures. Companies such as Radio Corp. of America, General Dynamics/Astronautics, Martin, Boeing, Librascope, Lockheed and Sylvania adopted part or all of IDEP's formats, indexing, microfilming and other procedures to facilitate their own in-house and interplant test control and information distribution, according to Barbe.

A few specific instances of savings attributed directly to IDEP and cited by IDEP coordinators in the recent telephone canvass are:

- **Company A eliminated** 13 tests on five types of transistors, two of which were heavy usage types, on the basis of two reports it received through IDEP. Estimating man-hour costs of each test at $1,500 indicates Company A saved a total of $19,500. Three other IDEP reports enabled this same organization to cancel five tests on heavy usage parts at a saving of $7,500.
- **Company B discarded** planned tests on 75 each of 62 types of transistors at a material cost of $41,850 after consulting IDEP reports.
- **Company C did away** with an average of one major qualification test a month for a total savings of about $30,000.
- **Company D will save** 300 hr. by eliminating two tests which another company reported it is planning through PIDEP. At $10 per hour labor cost, Company D is saving $3,000.
- **Company E shortened** eight qualifications tests, saving $1,650 per test, for a total of $13,200.

Other instances of savings provided by IDEP to which no specific dollar value can be assigned include the following:

- **Company F cut the size** of samples in a run of semiconductor tests.
- **Company G contacted its vendor** and realigned a test plan to agree with the known and potential weakness of a specific component.
- **Company H established** a failure analysis system on an ICBM program.
- **Company I initiated corrective** effort when it learned through inquiry among IDEP participants that the glass seal on a given component might crack.
- **Company J eliminated** an unreliable connector type on a ground support equipment package for an aerospace vehicle.
- **Company K was assisted** in the selection of parts and vendors.

One cause of irritation arising in IDEP centers over the vendors' opportunity to comment or challenge individual company reports before they are circulated to IDEP members. The armed services urge, but have not compelled, contractors who have prepared reports to show them to vendors before submission to IDEP. The vendors naturally are desirous of having this reviewed. This step is urged upon contractors, not to obtain the vendor's consent to the report, but to give him an opportunity within a stipulated period to offer explanatory remarks which can be appended by the contractor to the report. This gives the vendor a chance to defend his product and the contractor an opportunity to obtain some desirable feedback without delaying the submission of the report to IDEP.

Related Activity

In a related activity, IDEP is proposing a specification on how to write parts test reports and, when to write a formal report. Three man days of effort is the arbitrary time selected for the latter.

The PIDEP program is designed to perform these functions:

- **Inform contractors** when tests they schedule or conduct are being duplicated because others are planning comparable tests, have added identical parts or component types to their test schedules or a change in the requirements for the part arises.
- **Give prospective tester** a chance to

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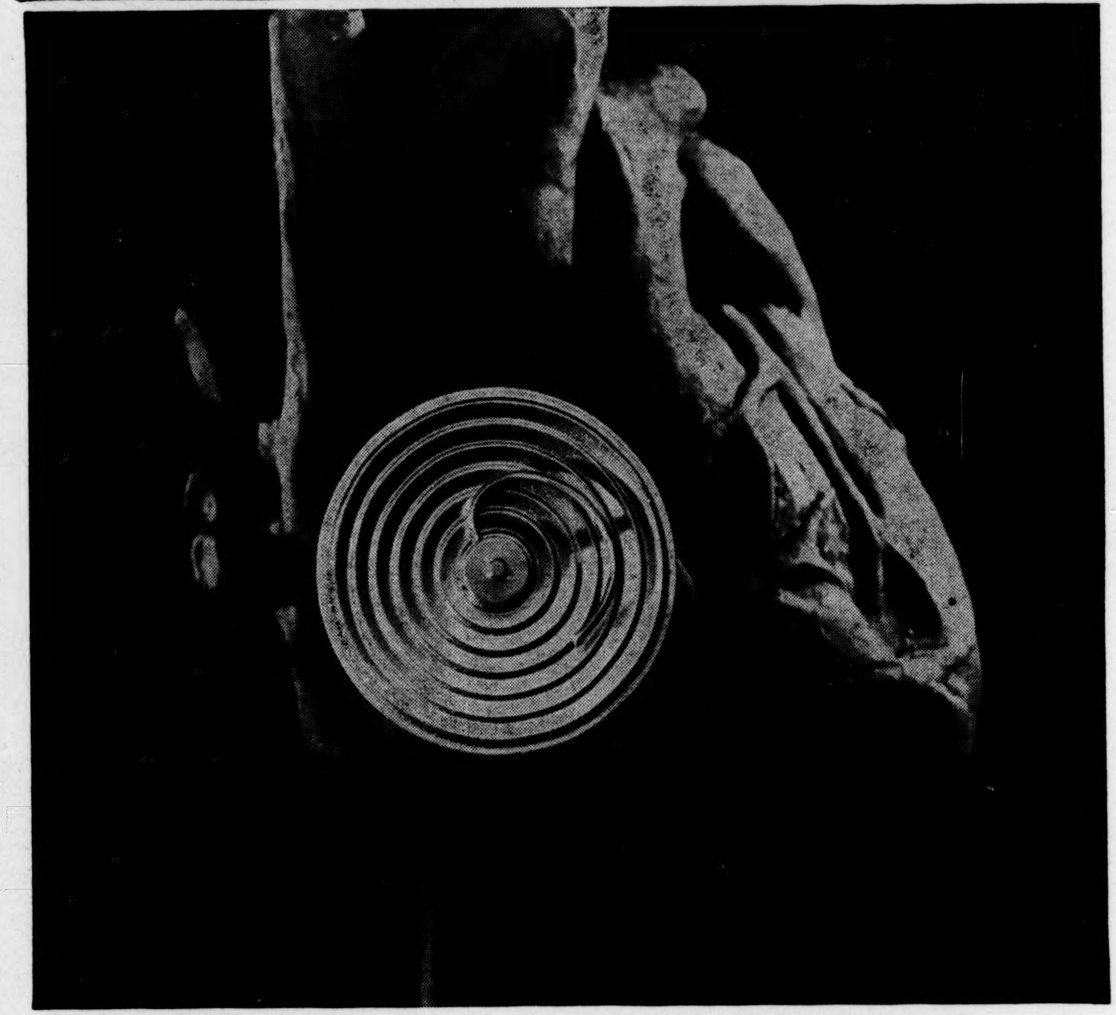
PRESSURE
SENSING



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review projected tests or tests in process to avoid duplication.

- **Coordinate information** on testing requirements in specific parts areas, permitting discussions to be held among contractors before tests to encourage cooperative planning.

Contractors and agencies now participating in IDEP can also work through PIDEP. In September, 52 reports were contributed by PIDEP participants. While this is only a trickle compared with what would be necessary for it to be a success, the program is only now getting under way.

According to the PIDEP plan, a Test Planned or In-Process (TPIP) form for each test is submitted by the contractor.

Two copies are sent to the service data distribution center where they are duplicated on cardstock and copies distributed to interested participants. Less than a week elapses from the time a report arrives at the service center and is distributed to participants. This shaves considerable time off the period required in IDEP where the process of microfilming a complete test report slows the distribution process.

As an assurance that TPIP cards are brought up to date, changes, reschedulings or cancellations are circulated immediately or TPIP cards which supersede previous ones are reissued. The information offered on TPIP cards ultimately would be contained on IDEP summary cards.

The volume of TPIP cards is expected to be about 100 per week with roughly a fifth of the changes and corrections outdating the original card. The total file may average 2,000 cards.

FILTER CENTER

▶ **Transistor Makers Adopt "Burn-in"**—Increasing numbers of transistor manufacturers are adopting practice of operating the devices under power, sometimes at elevated stresses, prior to shipment to weed out unreliable transistors—a practice previously used by tube manufacturers for the same purpose. Speaking at the recent Semiconductor Reliability Conference in Washington, General Electric's Conrad Zierdt said GE tests indicate that a 48-hr. high-stress exposure at elevated temperature and voltage, followed by two weeks of burn-in at normal values, appears to weed out most of the potentially unreliable devices. Julian Hilman of General Instruments reported that 300 hr. of burn-in at elevated temperature screens out 85% of the potential failures. James N. Perry of Transitron advanced the hypothesis that a batch of transistors may contain a fixed number of potential failures most of all of which can be detected in advance of shipment by high-stress tests.

▶ **Promising Thermo-electric Material**—Bell Telephone Laboratory scientists have developed new thermo-electric material using bismuth-antimony which has figure of merit of 0.005, nearly twice as good as any other known material, at low temperatures of around 80K. This suggests material will find use for Peltier cooling rather than as a thermo-electric generator.

▶ **Transistor Sales Climb**—Transistor sales for first eight months of the year totaled 117 million units, an increase of 50% over the same period last year, but dollar volume for same period was $200 million, an increase of only 1% over 1960, according to figures released by Electronic Industries Assn. The rising unit volume with practically no increase in dollar volume explains why the semiconductor industry is still depressed. Receiving tube sales for first eight months totaled 243 million, a drop of about 9% from 1960, with dollar volume down proportionately. Average price per transistor was $1.70, compared with 83 cents for average receiving tube.

▶ **Soviet Klystron Produces 20 Megawatts**—Measure of the high-power tube art in the Soviet Union can be gained from recent U. S. translation of a Russian article published in 1959 which describes a klystron tube capable of producing 20 megawatts peak power at 10-cm. wavelength. The Russians freely credit an American klystron as the basis for their development, but say that changes in design made by Soviet scientists resulted in a tube with considerably better efficiency, reliability and service life.

▶ **Semiconductor Industry Concerned**—Semiconductor manufacturers view the current Justice Department-Federal Grand Jury investigation (AW Aug. 21, p. 26) of semiconductor device pricing far more seriously than many of them care to admit. For one thing, the expenses involved in retaining top quality legal counsel and the time and effort required to gather subpoenaed information—at a time when the entire industry is cutting costs to the bone—will be staggering. For another, much of the subpoenaed information, which even includes individual desk calendars, doesn't exist. The industry expanded so quickly and product demand increased so rapidly that detailed records frequently were not kept. The investigation likely will center on suspicion of price fixing in the 1957 to early 1960 period.

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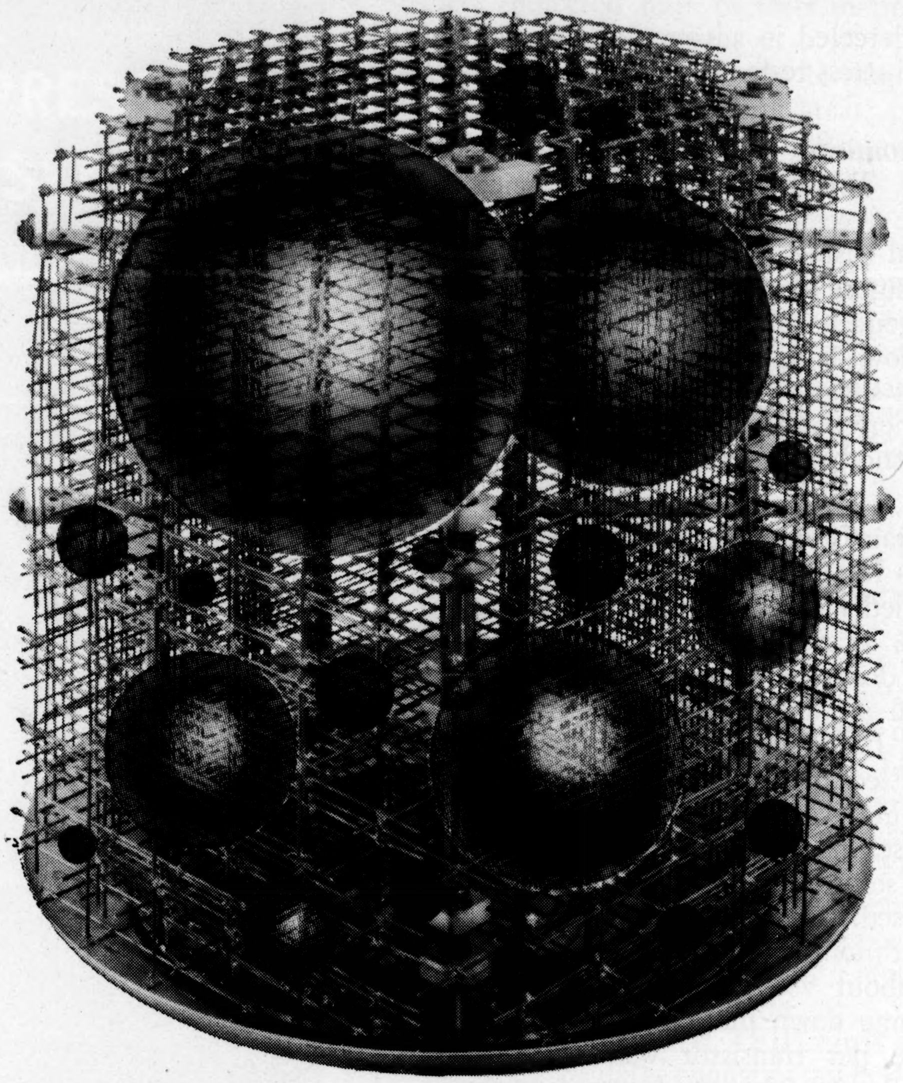

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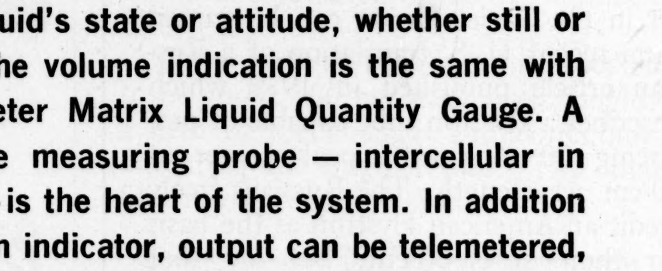

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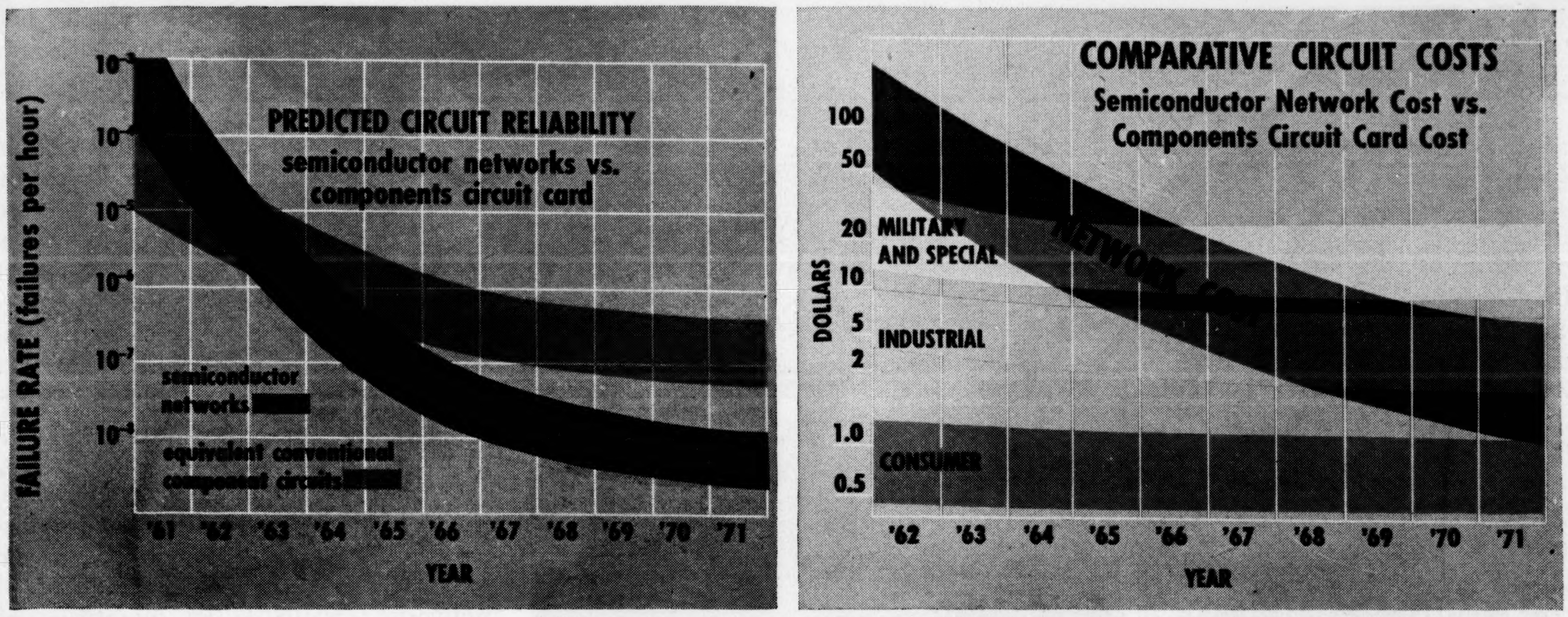


RELIABILITY of semiconductor networks should equal that of conventional construction by 1963, then quickly surpass it, according to Texas Instruments. Curve at right shows how cost of solid-state circuits (semiconductor networks) is expected to be competitive with conventional construction for small-quantity military production by 1963, and become less expensive within five years.

Semiconductor Network Gains Predicted

By Philip J. Klass

Washington—Micro-miniature solid-state circuits fabricated on tiny semiconductor crystals should match the reliability and cost of conventional construction techniques within several years, then pull ahead in subsequent years, a Texas Instruments, Inc. official predicted here.

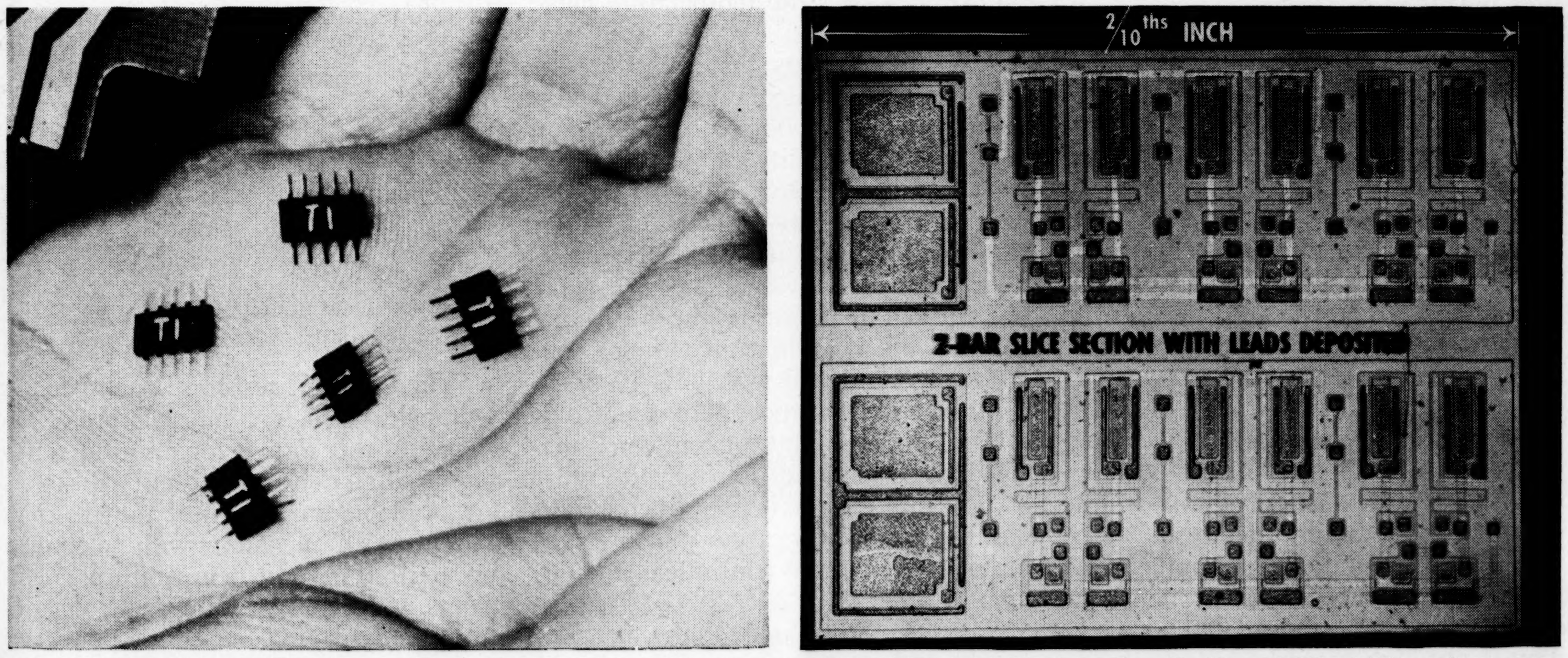
P. E. Haggerty, president of Texas Instruments, also revealed new details of the techniques used by the company in the fabrication of semiconductor networks, in a presentation which was made to government and industry representatives.

In addition to a tiny digital computer built for demonstration purposes (AW Oct. 30, p. 81), Texas Instruments is applying the new semiconductor networks to a pulse code modulation (PCM) telemetry encoder under contract to the Electronic Technology Laboratory of the USAF's Aeronautical Systems Division, Dayton. The resulting encoder is expected to weigh only 1/15th as much and occupy only 1/50th the volume of an encoder built with conventional miniature components, Haggerty said.

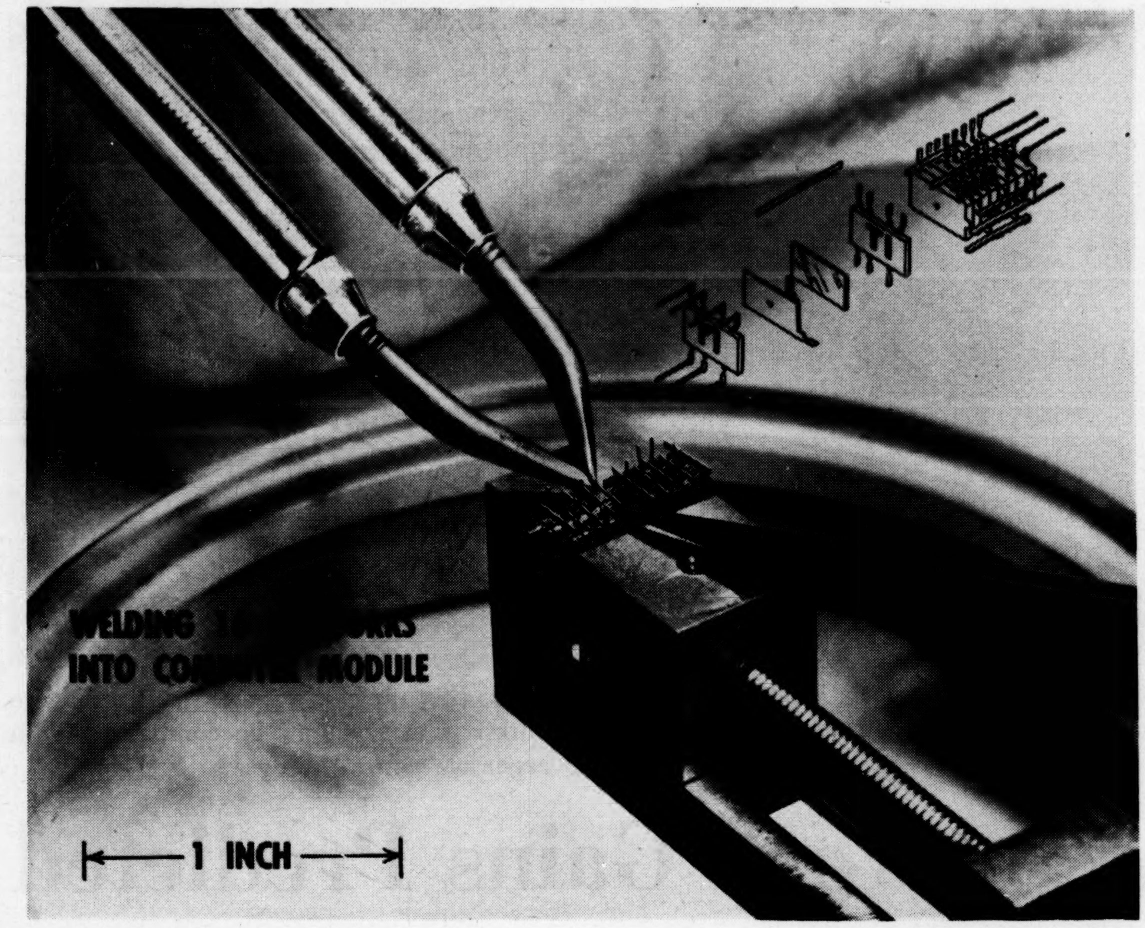
Company studies indicate that a sequence programmer for space vehicle use, which now occupies a volume of 220 cu. in. and weighs 7.3 lb. using the best of conventional techniques can be built in a volume of 15 cu. in. and with a weight of only 1.5 lb., using the new semiconductor networks. Similarly, a digital computer for guidance of an air-to-ground missile which now weighs 115 lb. and occupies 3,300 cu. in. could be built to weigh only 5 lb. and occupy only 50 cu. in., company studies indicate.

The new Texas Instruments Series 51 semiconductor networks, providing six different digital computer logic functions, are now available in quantities of a few hundred. Haggerty said the company plans to introduce the first of a new Series 52, providing analog functions, starting early in 1962, with the full line available by spring. This will include a low-level audio amplifier, operational amplifier, d.c. differential amplifier, video amplifier and a 1 to 3 watt power amplifier.

The six Series 51 logic networks now available, including a flip-flop counter,



SPACE AND WEIGHT SAVING inherent in new semiconductor networks is illustrated by these five flip-flops (left) which perform same function as conventional circuit board. Photomicrograph of two solid-state circuits prior to encapsulation shows components with interconnections. Six different logic functions are made from same basic circuit by altering interconnections.



FUNCTIONAL MODULE, consisting of a group of individual semiconductor networks, can be fabricated using discharge welding technique, followed by module encapsulation.

a flip-flop counter with emitter-follower, a NOR/NAND gate, a NOR/NAND gate with emitter-follower, two isolated NOR/NAND gates and an exclusive OR network, all are fabricated from one common semiconductor network design.

Using diffusion techniques, a total of 29 individual components are fabricated on a single silicon wafer, measuring approximately 0.15 x 0.07 in., regardless of whether all the components are needed for the particular logic function. This number includes six transistors, six diodes, eight capacitors and nine resistors. Similarly, a number of conducting paths are deposited on every wafer, some of which may not be used in the final network.

When the wafer fabrication has progressed to the point where it must be tailored to a specific function, the required connection paths are interconnected by depositing the required additional conductors.

This procedure allows approximately 80% of the process steps to be standardized, with resulting manufacturing economies, Haggerty said.

At present, the characteristics of all six of the transistors produced on a silicon wafer have essentially identical characteristics. With added experience it should be possible to alter the characteristics of individual transistors within the network, Haggerty predicted.

The demonstration computer constructed with semiconductor networks operates at a clock rate of 100 kilocycles. This is not high speed by today's standards, but the extremely compact construction and short interconnecting leads inherent in solid-state circuits should ultimately permit operation at extremely high clock rates.

After external connection leads have been attached by thermal compression bonding, the silicon wafer is hermetically sealed and emerges with dimensions of $\frac{1}{4}$ x $\frac{1}{8}$ x $\frac{1}{32}$ in. Groups of such networks can then be stacked into modules and interconnected by supporting bus bars using conventional welded circuit techniques. The entire module can then be encapsulated if desired.

Power consumption of individual networks ranges from two to four milliwatts in the Series 51 line, and they can be operated over the temperature range of −55C to 125C.

Haggerty predicts that by 1963 the reliability of semiconductor networks should reach that obtainable with conventional high-quality components, and move ahead by 1965. This prediction of greater reliability for semiconductor networks is based on the fact that as many as 300 individual processes may be required to fabricate the individual components used in conventional construction, compared with only 15 or 20 required for the semiconductor network.

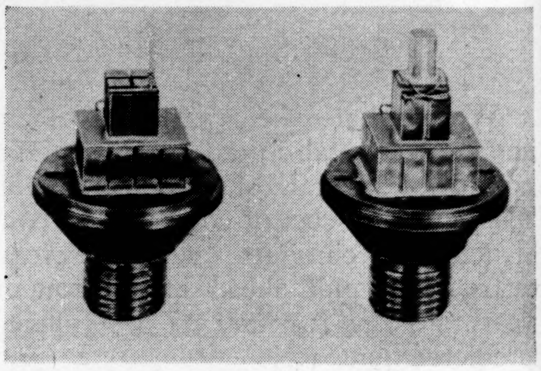
Additionally, the semiconductor materials used in solid-state circuits must of necessity have extremely high purity and the whole fabrication process takes place in a carefully controlled environment.

The significant reductions in size, weight and power consumption should also permit increased use of circuit redundancy to improve over-all reliability.

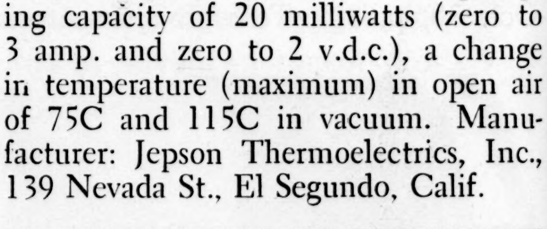
Costs of the new semiconductor networks should be competitive with conventional military construction in small-run quantities by 1963, becoming competitive with high production run quantities by perhaps 1965, Texas Instruments studies indicate. This is based on inclusion of cost of conventional components, their assembly onto circuit boards and related overhead expense.

The cost of the semiconductor networks is directly related to production yield, and this in turn depends upon the ability to precisely control each step in their fabrication. Haggerty indicated that present yield is not too far below that obtainable with individual transistors. This, he said, is reflected in the prices which TI now is quoting for the networks: $50-$65 in quantities of 1,000; $95-$115 in sample quantities.

NEW AVIONIC PRODUCTS



- **Thermoelectric coolers,** a line of two and three stage cascaded thermoelements that reach −95C from a sink temperature of +20C with input of 3 amp. maximum at 2 v.d.c. Cooler modules are mounted on base at factory according to customer specifications. Model 615-5-1, a three-stage cooler, has maximum active heat pumping capacity of 20 milliwatts (zero to 3 amp. and zero to 2 v.d.c.), a change in temperature (maximum) in open air of 75C and 115C in vacuum. Manufacturer: Jepson Thermoelectrics, Inc., 139 Nevada St., El Segundo, Calif.



- **Wire wound resistors** packaged as rectangles $\frac{1}{8}$ in. x $\frac{1}{4}$ in. square, are designed in this format for uniform stacking in high-density systems. Resistors are available in resistance ranges from 1 ohm to 1.2 megohms with tolerances up to 0.01% and temperature coefficients as low as ±3 ppm. per deg. C from zero to 100C and ±5 ppm. per deg. C from −55C to +125C. Manufacturer: General Resistance, Inc., 430 Southern Blvd., New York 55, N. Y.

African Carrier Lists Fiscal 1961 Profit

Central African Airways, based in Southern Rhodesia and flying mid-African routes, declared a Fiscal 1961 net profit of $263,226. The profit was earned despite turbulence on the continent, the airline's withdrawal from Zambezi service last October, and the grounding of its Viscount aircraft due to wing modifications.

Profit was announced by R. M. Taylor, chairman of Central African. He said that the airline envisaged "no subsidy requirement" for the year ahead despite the fact that certain of Central African Airways' routes continue to be unprofitable, e.g. flights into Barotseland and Nyasaland.

In the 1960-61 fiscal period, Central African carried 201,004 passengers, according to the company, an increase of 22,549 or 13% over the previous year. In the same period, the carrier handled 2,110 tons of freight, an increase of 14% over the previous year's figures. Growth of air mail, according to the company, "was disappointing."

Taylor attributes much of the passenger increase to the airline's increased activities in the marketing of "inexpensive, all-inclusive seaside tours to the East African and Natal coasts." These and reciprocal tours to South Africa are the major reasons for the increased passenger activity, according to the company.

Another recent Central African innovation has been the introduction of Douglas DC-3 Skybus service between Salisbury and intermediate points.

Airline's fleet consists of Douglas DC-3s, de Havilland Beavers and Viscount 700Ds; route structure includes:

- **Flights into northern Rhodesia** with DC-3s and Viscounts.
- **Service to Nyasaland** where Viscounts are being phased in to replace DC-3s.
- **Southern Rhodesian flights** with an improved timetable.

New Offerings

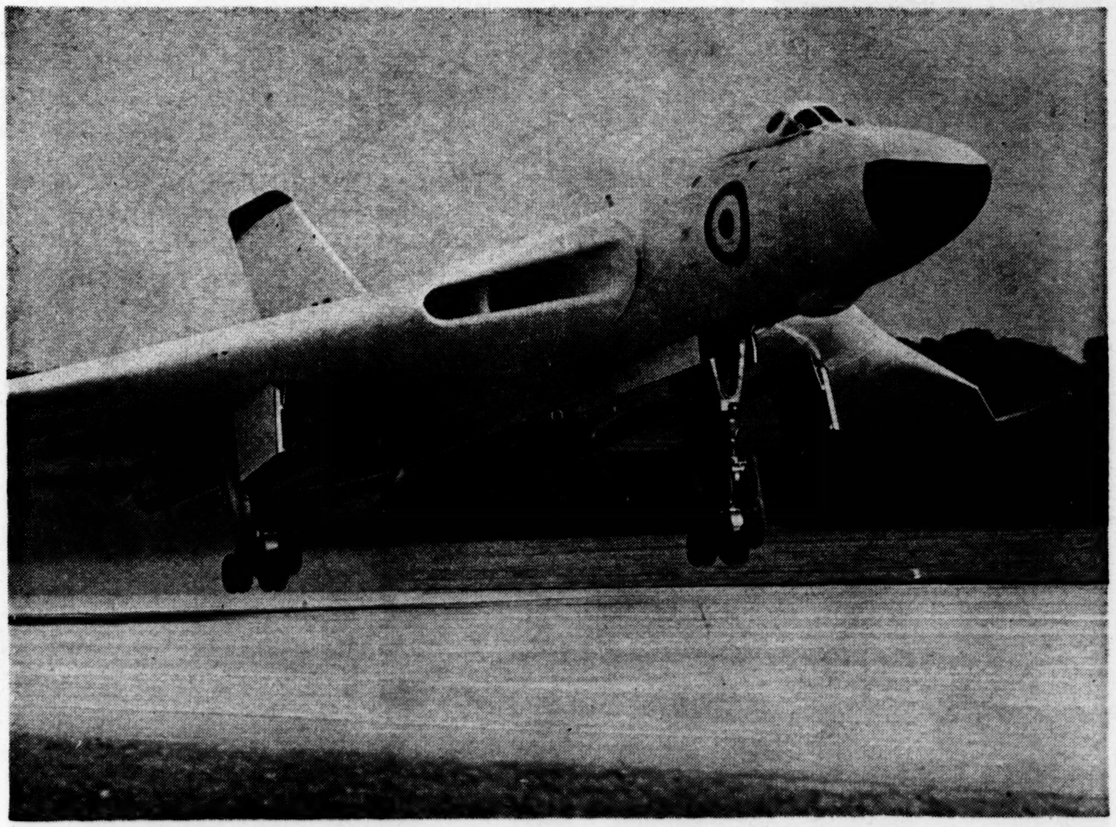
Babcock Electronics Corp., Costa Mesa, Calif., engaged in the development and manufacture of electronic units for remote control systems designed to control the navigation and operation of unmanned aircraft and missiles by radio, and the manufacture of sensitive miniature and subminiature relays having general use in the electronics industry. Offering is 300,000 capital shares; 50,000 shares by the company, and 250,000 shares by the present holders. Of the company's proceeds, $600,000 is for bank loan payment.

Precision Microwave Corp., Millis, Mass., engaged in the manufacture of specialized microwave components for radar detection and missile guidance systems and communication systems, and specialized components for commercial and military jet aircraft engines. Offering is 165,000 common shares at $10 per share; 115,000 shares by the company, and 50,000 shares by the present holders. Of the company's proceeds, $142,990 will be used for the retirement of sundry indebtedness; $199,000 for the retirement of certain accounts payable; $150,000 for additional technical personnel and for research and development projects in the microwave field.

Astrodata, Inc., Anaheim, Calif., engaged in the development and manufacture of high speed electronic data handling equipment, range timing equipment, and standard electronic products. Offering is 200,000 capital shares for public sale by the company, and 625,000 outstanding capital shares owned by Epsco, Inc., the company's principal stockholder, for subscription by Epsco's common stockholders at the rate of one company share for each Epsco share held. The company's proceeds will be used in part to retire short term bank loans.

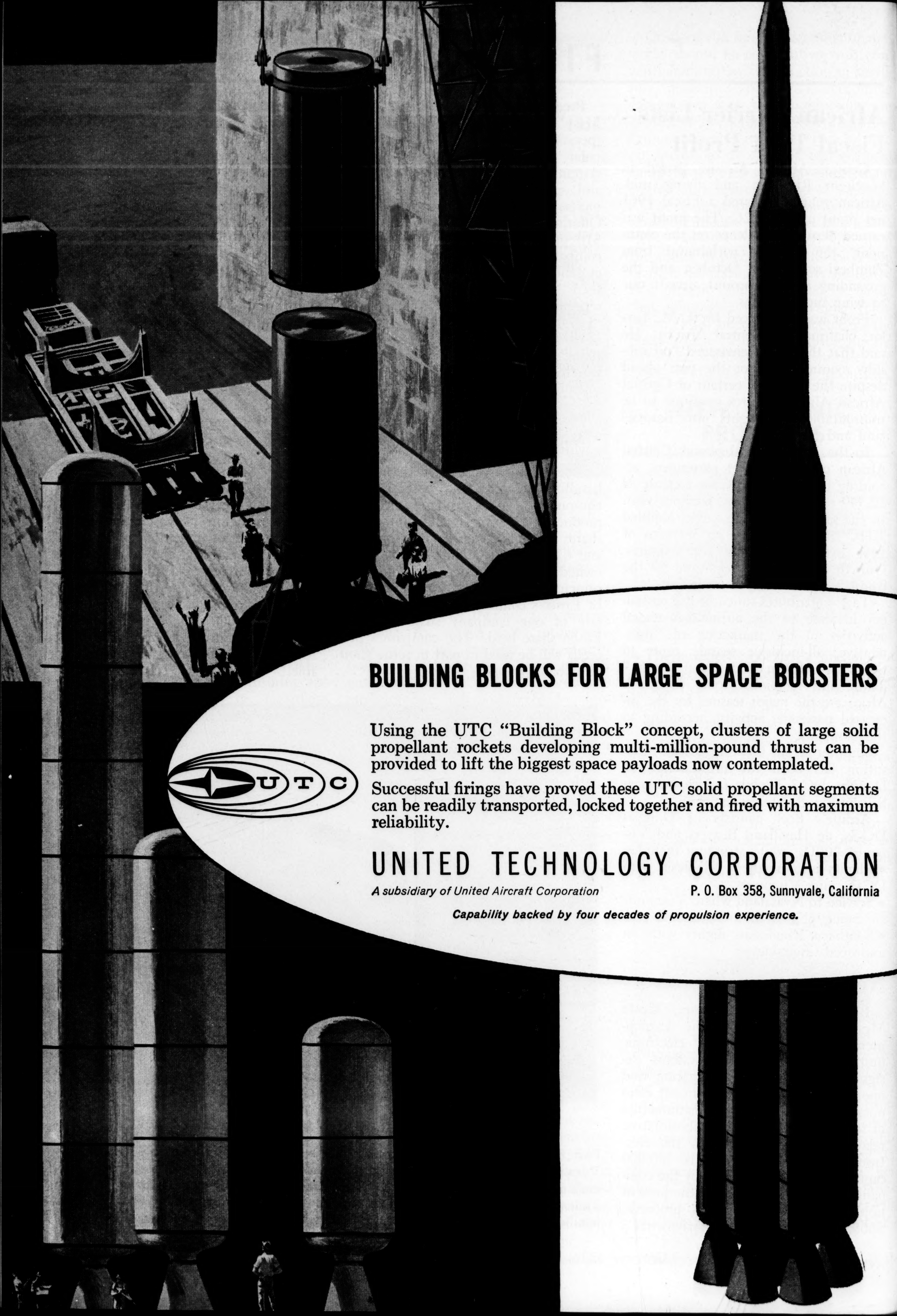
Aerological Research, Inc., Long Branch, N. J.; the company has acquired all the stock of Craig Instrument Corp., which has been engaged in research, development, design and manufacture of electrical, electronic and mechanical equipment and instruments for private industry and the government in the meteorological field. The company proposes to engage in research, experimentation, development, design and manufacture involving processes and instrumentation in the fields of aerology, meteorology, atmospheric phenomena, environmental engineering, weather modification and control, medical electronics, etc. Offering is 100,000 common shares at $3.50 per share. Proceeds will be used for research and development, new equipment and machinery, increased inventories, promotion, sales and advertising.

Regen Precision Industries, Inc., North Arlington, N. J., engaged in the manufacture of precision parts, components, assemblies, and subassemblies for the business machine, electronic, missile and aircraft industries. Offering is 100,000 common shares. Of the proceeds, $300,000 will be used for tools, equipment and machinery for a plant addition; $40,000 to satisfy loans payable.



Speys Tested on Vulcan V-Bomber

First flight of Rolls-Royce Spey bypass turbojet engine was made in this Avro Vulcan V-bomber. Two Speys are mounted in the inboard nacelles; outboard engines are the Vulcan's normal Bristol Siddeley Olympus powerplants. Spey will be used in the de Havilland Trident three-jet transport, and the BAC 111 twin-jet transport; military version will be installed in the Blackburn NA.39 strike fighter.



BUILDING BLOCKS FOR LARGE SPACE BOOSTERS

Using the UTC "Building Block" concept, clusters of large solid propellant rockets developing multi-million-pound thrust can be provided to lift the biggest space payloads now contemplated.

Successful firings have proved these UTC solid propellant segments can be readily transported, locked together and fired with maximum reliability.

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MISSILE ENGINEERING

Transportable Bomarc Proposed To USAF for Flexible Deployment

Boeing Co. is proposing a transportable IM-99B Bomarc missile system to USAF for increased defensive capability without the additional high costs and long lead times of fixed sites.

Major reason behind the proposal stems from the 32-month lead time required to expand an existing site or install a new one. Boeing estimates 26 months for construction time plus another six months for make-ready time on the finished site. Costs of sites vary widely depending on local labor markets, soil conditions, and other factors.

The proposal emphasizes that this long lead time can be traded for equipment which requires no more than a nine-month lead time for delivery of combat-ready missiles, complete with launchers and all support equipment.

Standard Erector-Launcher

The proposed system is based on the use of standard commercial truck-trailer chassis. All equipment now in fixed-site Bomarc shelters is either relocated on the trailers or repackaged in small vans. Each missile is mounted on its standard erector-launcher at the rear end of the trailer.

Fairings protruding from the normal outlines of the trailers cover the Bomarc wings and tail surfaces. These fairings increase width, but not height, of the trailers beyond those standard for current highway systems. However, escorted convoys move loads of even greater dimensions over the open roads, and Boeing foresees no problem in highway transport.

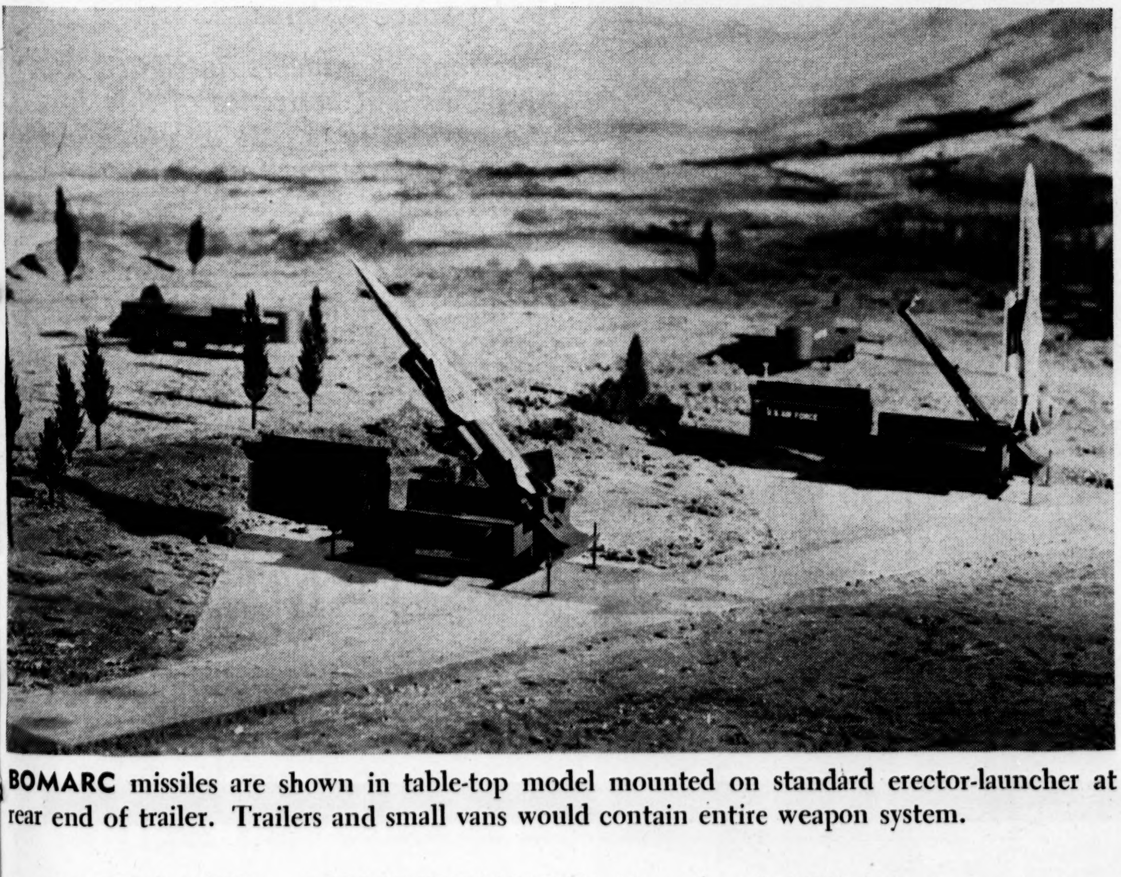
System is also designed to be air-transportable, but the 18-ft. wingspan of the Bomarc probably would make it necessary to demount wings for travel by air in either the current Lockheed C-130 series of the Lockheed C-141.

Increased flexibility of the Bomarc anti-aircraft missile can be obtained in a number of ways with a transportable system. Strength of an existing fixed site, which currently has no refire capability, can be increased through deployment of additional rounds on cleared ground nearby.

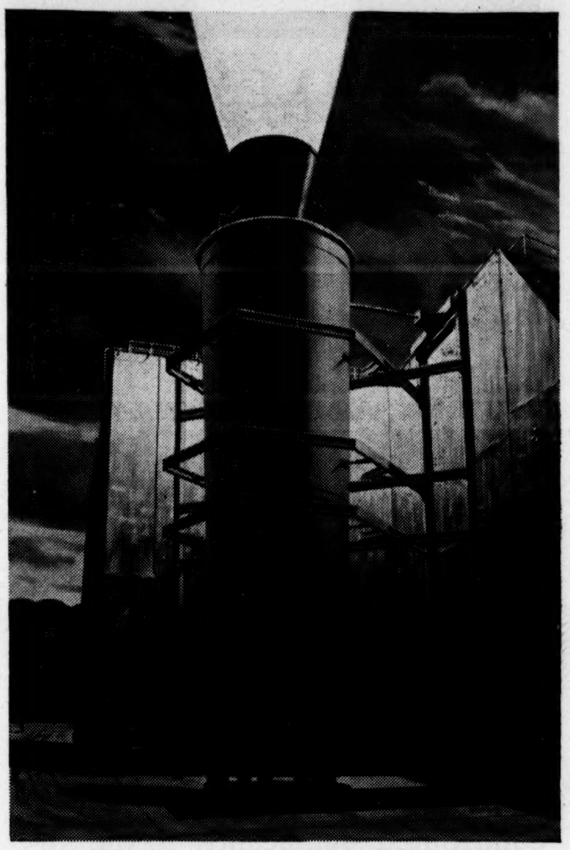
Areas currently unprotected by Bomarc missiles, or where the fixed-site installation is not completed, could be covered by transportable elements on a temporary site.

Bomarc squadrons could be moved from site to site to meet a changing threat without the need to build a fixed installation.

Finally, the system could be moved into a remote region of the world where area air defense would be needed to meet the problems of local conflicts. After the situation had calmed down, or had ceased to be a crisis, the Bomarc units could be moved out or reduced in strength without having to abandon property or facilities of large value.



BOMARC missiles are shown in table-top model mounted on standard erector-launcher at rear end of trailer. Trailers and small vans would contain entire weapon system.



Department Head—Aerothermodynamics

This new position is currently available in our Engineering Sciences activity. We are seeking an outstanding scientist who has the stature and maturity to provide technical leadership for a small group of highly qualified aerothermo specialists performing studies concerned with advanced rocket propulsion systems.

The position requires a high degree of creativity. Selected candidates will possess a record of major responsibility and accomplishment in this field, and will be thoroughly knowledgeable in analysis and test work. An advanced degree, preferably a doctorate, in mechanical or aeronautical engineering with a minimum of five years experience is required.

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If you are interested, we invite you to contact C. F. Gieseler, Dept. 109-A, United Technology Corporation, Box 358, Sunnyvale, California. All replies treated in strictest confidence.

All qualified applicants considered without regard to race, creed, color or national origin.

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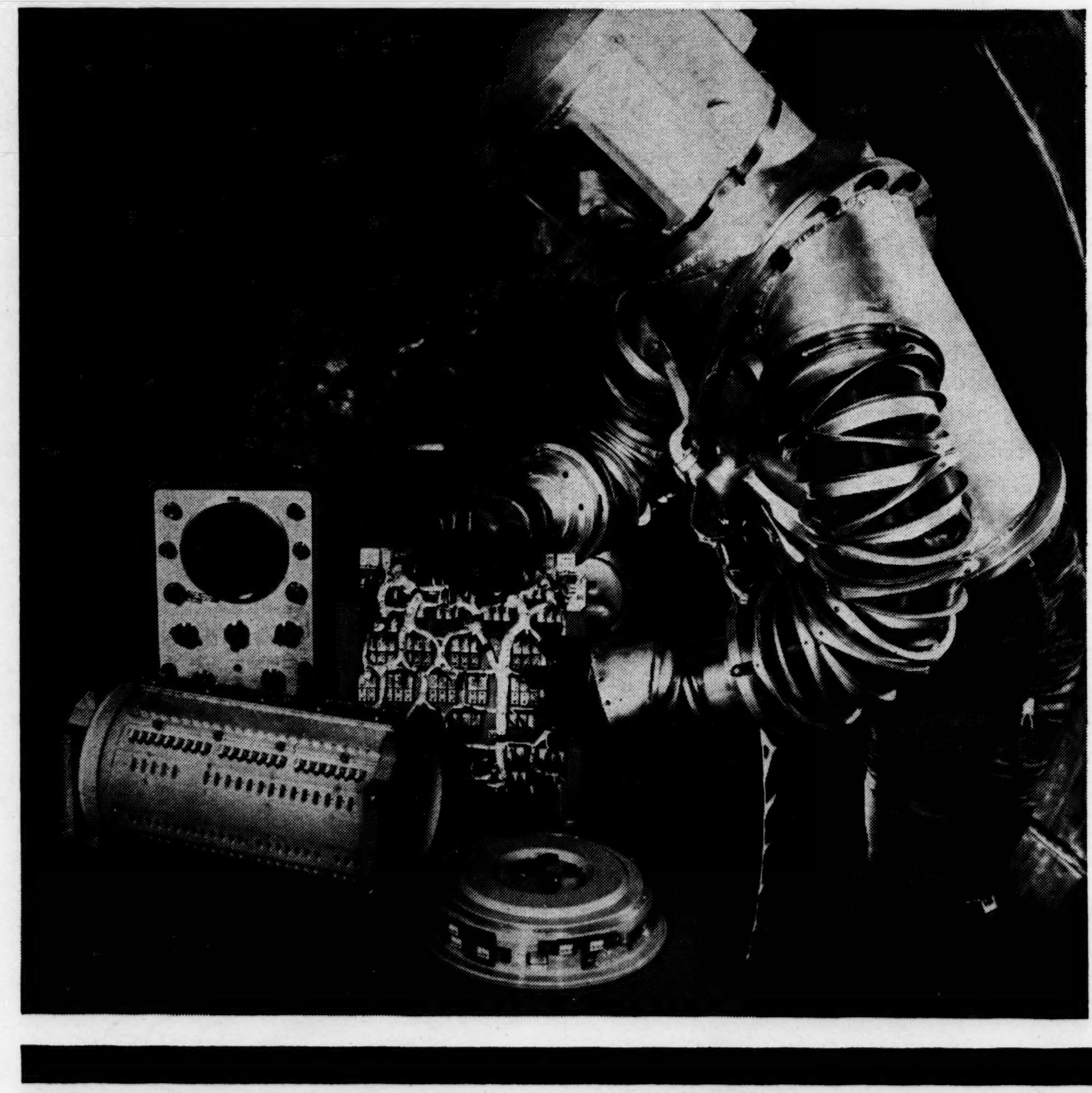
ACCLIMATING MAGNETIC DRUMS TO SPACE

Giant strides have been taken in developing the magnetic storage drum for ground and airborne electronic systems during the past decade. Equally ambitious strides remain to be taken before magnetic drums can be confidently committed to space projects.

Litton Systems engineers who have contributed significantly to the improvement of the magnetic drum – a key element in Litton's ground and airborne electronic data systems – are now preparing this highly essential component for space vehicles. Problems they are investigating include friction created by the absence in space of the boundary-layer lubrication phenomenon, the erratic behavior of electrons at hypertemperatures, and the effects of vibration caused by post-launch acceleration.

Aspects of these problems were recently investigated by Litton engineers who subjected a Litton-developed, 6-inch lightweight magnetic drum and associated contact magnetic recording heads to a series of high-vacuum vibration and altitude tests. Drum and heads (without built-in lubricants) were operated at simulated altitudes in excess of 300,000 feet and vibrated at frequencies as high as 50g rms (bandwidth 20 to 2000 cps).



Primary objectives of the high-vacuum tests were to determine: (1) Tendency of heads to bounce on drum surface under shock or vibration. (2) Relationship of recording signal level and equipment wear to contact head pressure. (3) Dependency of head flutter on air density.

Both drum and recording heads operated without loss of information during these tests, indicating that additional tests to prove the feasibility of magnetic drums, contact heads, and associated electronics for outer-space applications are fully warranted. The next series of tests will be designed to determine the effects of cosmic radiation on electronic and mechanical equipment. Still other tests will then be conducted to study the performance of equipment in the temperature extremes of space.

Litton has successfully developed and is now producing complete data systems incorporating magnetic drum storage and retrieval subsystems that use contact heads for reading and writing digital data. Litton engineers have little doubt that what they have accomplished for ground and airborne systems, they will also be able to do for space systems.

Electronic engineers intrigued by problems and activities of this sort and anxious to negate or prove out Litton approaches are invited to write, phone, or visit. Contact Don Colvin, Litton Systems, Inc., Computer Systems Laboratory, 5500 Canoga Avenue, Woodland Hills, California. Or telephone DIamond 6-4040.

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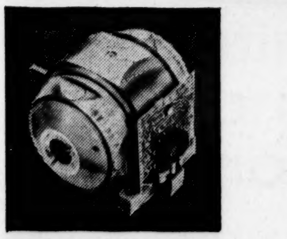

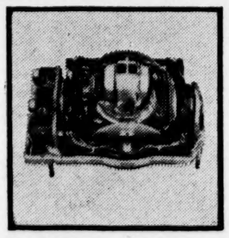

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Cessna Optimistic Over Sales Prospects

By Erwin J. Bulban

Wichita, Kan.—Cessna Aircraft Co. stands a good chance of setting a record in business aircraft sales in 1962, Senior Vice President Del Roskam stated during the company's annual international distributor-dealer meeting here last week. The projected business would top Cessna's previous mark, set in 1960, when it delivered $56.1 million worth of commercial aircraft and spares.

Even should the U. S. economy suffer the adverse tremors in mid-summer that are predicted by some U. S. industrialists, Roskam said he was confident that Cessna business aircraft sales will still exceed 1961's volume by at least 10%.

Management's bullish attitude for the company's prospects has been expressed by investing more than twice the money for improvement of its 1962 line than it has spent in this area in any previous year, he added. Although he declined to disclose specific figures, he indicated that development costs for next year's line ran just under $10 million.

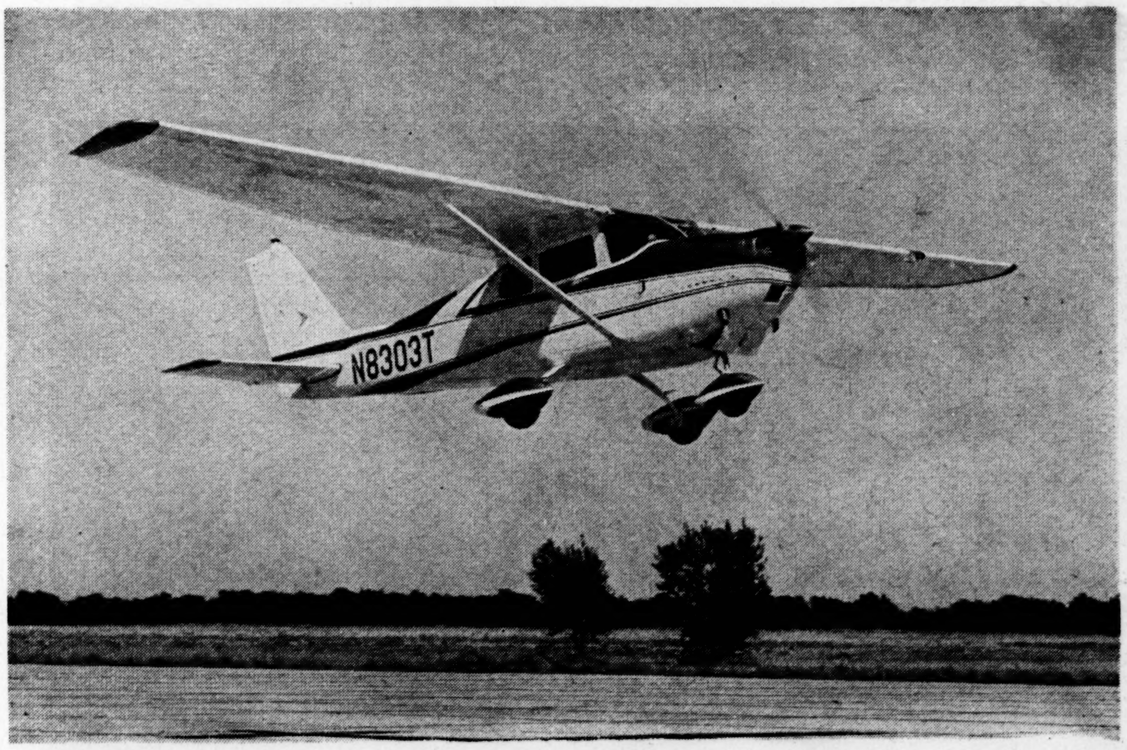
Confident view of 1962 business, expressed by Cessna top management, is also of particular significance to its numerous suppliers with whom it shares approximately 50% of the cost of its products.

Discussing new product and marketing developments, Roskam noted that:

- **Formal announcement** of arrangements that Cessna has concluded with the Argentine government for production of the company's business and utility aircraft in that country can be expected very soon. The company has been conducting negotiations for two or three years and indications are that this project will be under way in a few months—the initial type being the Model 172.

The arrangement marks the first step Cessna has taken in its long-range planning to have its airplanes built wherever foreign markets and competition warrant the move. As Roskam pointed out, Lockheed-Kaiser already has moved into Argentina and two foreign companies have indicated interest in the Latin American area. One of the latter has signed an agreement for production in the Southern Hemisphere, but has not yet made a move. Although Roskam declined to name companies and areas, the countries involved are Argentina and Brazil and one of the companies is Morane-Saulnier which an industry

CESSNA 150 for 1962 has redesigned wing tips, main gear moved aft.



SKYLARK, above, has new cowl flaps, constant speed propeller. Gross weight is up 100 lb. Optional family seat, below, increases capacity of Skylane and Skyhawk to six persons.

observer, familiar with the negotiations, said, plans to build approximately 60 Rallye three-place lightplanes in Latin America.

- **Excellent progress** is being made on the new twin-boom Model 336 Skymaster, which features fore-and-aft mounting of its 210-hp. Continental IO-360-A engines. The prototype has completed 100 hr. of flight testing, of which approximately 25 hr. have been on the production configuration, which features added vertical fin and elevator area to improve its handling characteristics and improvements in engine cooling and airflow around the fuselage. The Model 336 is expected to complete company trials in the next few months, prior to starting its formal Federal Aviation Agency certification trials and is expected to join the company's product line next year.

Because of its powerplant configuration, Federal Aviation Agency still is studying the problem of whether it will require a single or multi-engine pilot rating for Skymaster pilots, although Cessna has submitted a proposal to the agency requesting that a single-engine rating be considered.

- **Future rotary-wing aircraft** plans currently are based on studying additional models lighter than its current Skyhook. Feeling is that greatest penetration of the civil market will be in a four-place aircraft in the $35,000-class and that this will have to be a practical helicopter embodying considerable utility and not a stripped-down machine, Roskam noted. Also needed is a two-place machine in the less-than-$10,000 bracket, with major emphasis on simplicity, he noted. The company has made, and is continuing to make, design studies on a large variety of configurations covering these rotary-wing classes, Roskam stated. This could be either a gyroplane or helicopter.

- **Agricultural airplane,** specifically tailored for this market, is another Cessna study project. Roskam stated that the company thought a year-and-a-half ago that they had reached the point where they had a design ready, but after further consideration, felt that it did not really represent "a breakthrough of a sort" that the company is seeking in this field.

- **No decision** has been reached yet on a final design for the 6 to 10-seat heavy twin project planned for introduction in the 1964 line (AW Nov. 1960, p. 32), although detailed planning has been completed on seven or eight designs in this class. Cessna still feels that they will have such an airplane ready late in 1964. Indication is, according to Cessna, that the product will have to sell for about $250,000 at most, fully equipped, to be favorably received. As to cabin pressurization, Roskam indicated that there is still much to be learned about these systems and their attendant costs: "About $40,000", is a major handicap of pressurization.

Thirteen models compose Cessna's business aircraft fleet for 1962, including three twins (the Model 310G, the Skyknight and the forthcoming Model 336 Skymaster), the single-engine Models 210, 182 and its de luxe counterpart Skylane, the Skylark, the 172 and its de luxe version Skyhawk, the 180, the 185 Skywagon, the 150 and the Skyhook.

With so many models in the line, the company finds that it cannot develop sufficient production for all to provide all of its distributor-dealer organization with a complete inventory immediately—also in some cases there is yet a field inventory among some dealers of 1961 airplanes—and as a result Cessna and its sales outlets have worked out a schedule of announcement of details of new models staggered over the next few months.

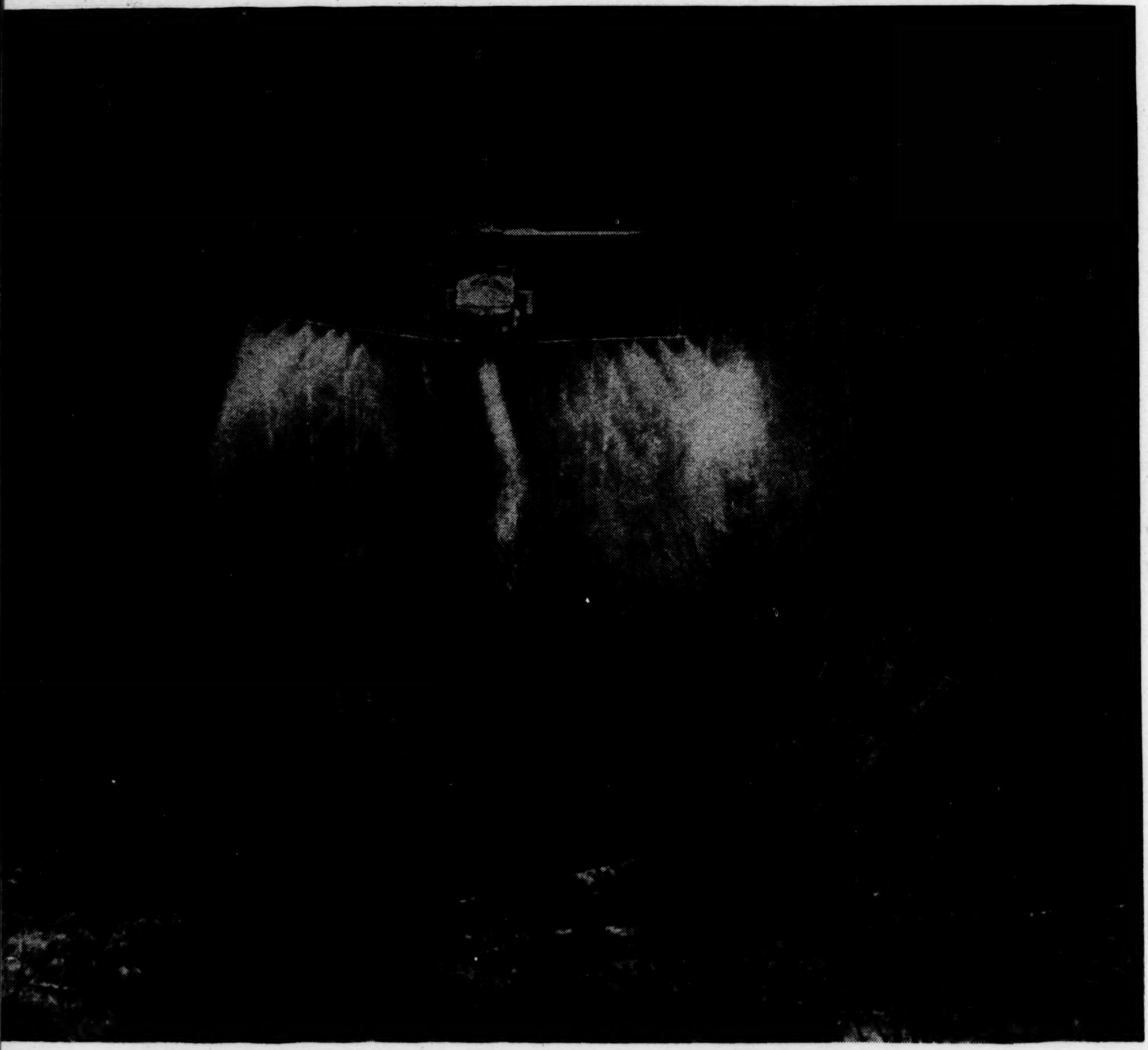
Models 150, 172, Skyhawk, Skylark, Skyhook and Skyknight were detailed at Cessna's recent meeting. Models 180, 185 Skywagon, 182 and Skylane will be revealed to the public Jan. 5 and Models 210 and 310G are scheduled for unveiling Feb. 2.

All models but the 310G were previewed during the meeting here. The reason given for withholding the 310G was that the company in February wants to go into the field to its distributor-dealer organization to inject a follow-up promotion aimed at maintaining the initial enthusiasm generated at the factory show. Keeping one model under wraps until then may provide a star attraction around which to build such a follow-on program.

Model Secrecy

Special precautions are being taken by the company to maintain secrecy on the features of new aircraft prior to their public showings. This year, the company is modifying its delivery method of new models from the factory to the field prior to their public showings using a technique copied from the automobile industry.

A special fabric zippered covering, apparently of light duck material, will be carried in each new model flown to the field organization prior to the announcement date. On arrival at the destination, the airplane will be completely covered in this bag, the zipper actuators being sealed with lead by the



Hiller 12E Downwash Aids Foresting Program

Poison spray, designed to kill unwanted plants and give smaller trees room to grow, is beaten into forest by 2,000,000 cu. ft. per minute rotor downwash of Hiller 12E, operated for forest rehabilitation program.

delivery organization and the bags being removed only for the public showing. Bags are contoured to the airplane's general configuration, but will not reveal specific details.

Initial flyaway from the factory of 1962 models by distributors and dealers totaled some 300 airplanes. Highlights of the first models unveiled publicly by the company include:

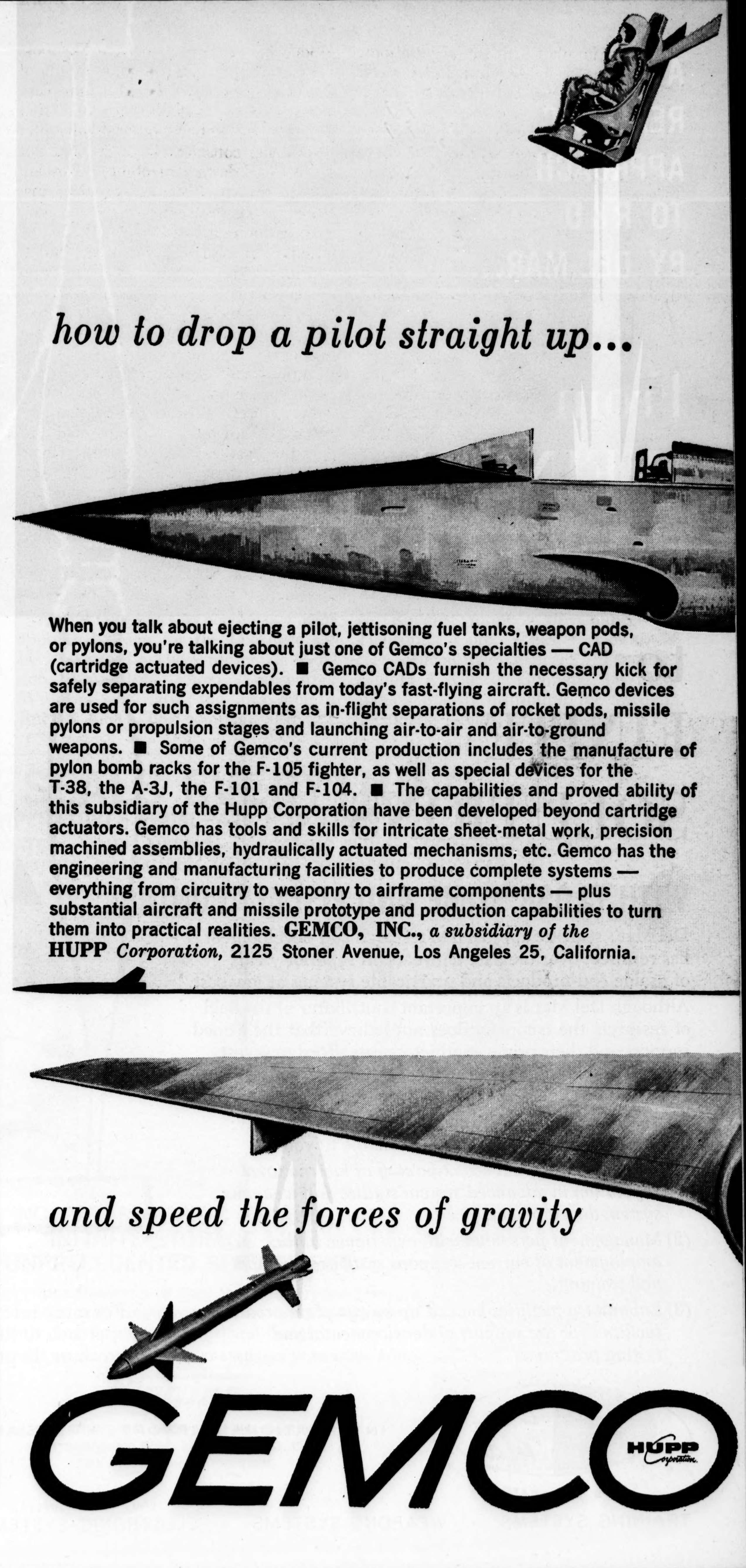
- **Models 172 and Skyhawk,** which have gross weight increased by 50 lb. over last year, for a new gross of 2,250 lb., providing an increase of useful load for the 172 from 949 to 990 lb. and for the Skyhawk from 880 to 920 lb. Airplane performance is retained through aerodynamic cleanup, including newly designed reinforced plastic wingtips having navigation lights faired in and needle-nose propeller spinners. Wingtips and spinners are interchangeable on Models 150 through the 180 series. The 1962 Model 172 is priced at $9,895, up $100 over last year's version and the Skyhawk is priced at $11,590, up $115.
- **Skylark** features a constant-speed McCauley C21-series propeller, especially designed for this airplane, utilizing hydraulic oil from the engine system. Other changes include the new wingtips and spinner, temperature control flaps on the engine cowling and magnetic fuel-level gages replacing the former thermal-type gages. Gross weight is now 2,450 lb., up 100 lb from the previous year and the useful load is up 85 lb. The airplane now sells for $14,125, an increase of $350. The former companion Model 175, which was the standard version of this airplane, has been dropped due to customer preference for the de luxe version.
- **Model 150** two-place lightplane has had its main landing gear relocated two inches aft of the center line to improve

Cessna 1961 Sales Drop

Reduced commercial and military sales last year resulted in total sales just over $87 million by Cessna Aircraft Co., Wichita, Kan., for its fiscal year ended Sept. 30, compared with $103 million the previous year.

Earnings for the year just passed were approximately $5,250,000, or $1.60 per share compared with $7,277,000 or $2.24 per share the previous year.

In announcing approval of the regular 25 cents quarterly dividend, payable Nov. 21 to holders of record Nov. 6, Cessna president Dwane L. Wallace reiterated the feeling expressed by other top officials at the company's recent distributor-dealer meeting that 1962 should be a good year and considerably better than 1961. He noted that more than $4 million in military follow-on business is expected to be received officially in the next few weeks.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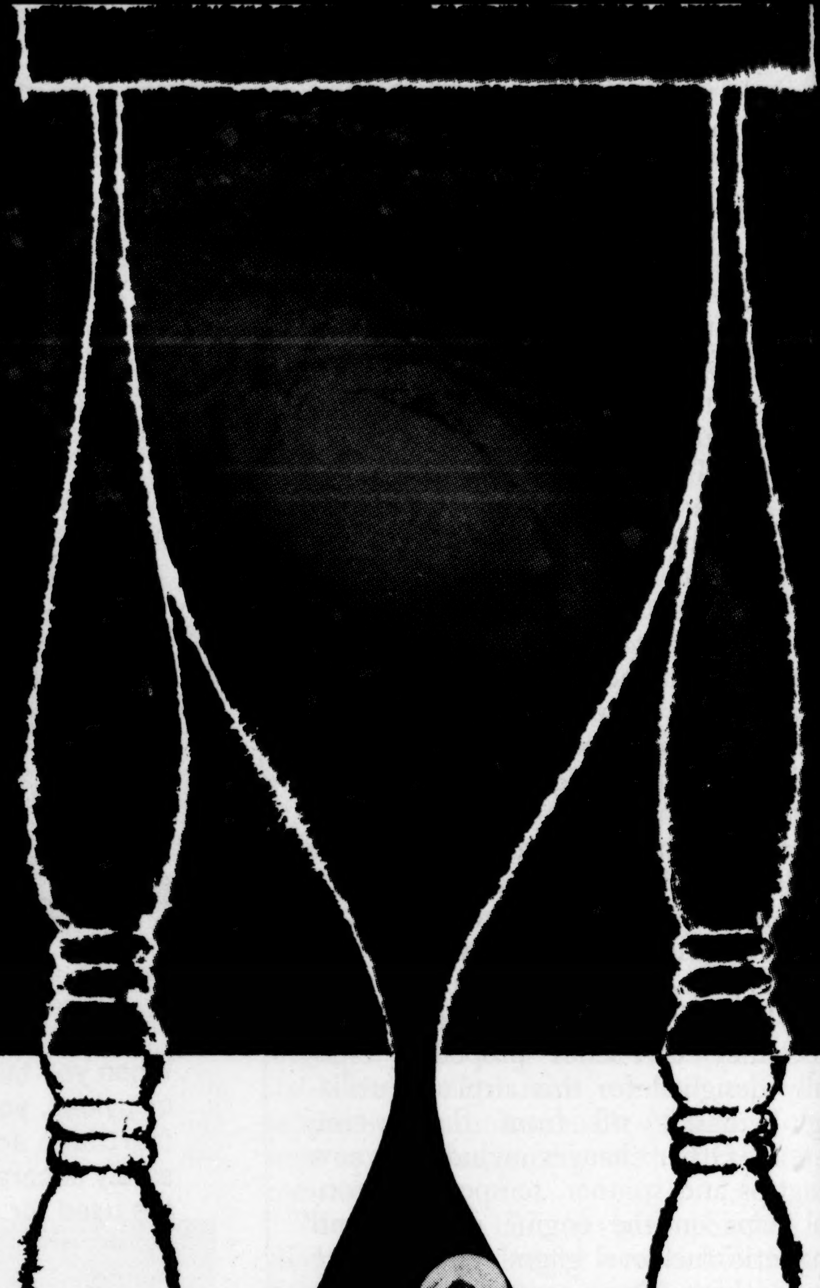

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ground handling and loading and also has the cleaner wingtips. Aerodynamic cleanup has increased the cruise speed to 127 mph., an increase of three miles per hour. Rate of climb is up 20 fpm. to 670 fpm. and service ceiling is 15,600 ft., an increase of 300 ft. No price increase is indicated on this airplane, the standard model selling for $7,495, the trainer for $8,400, and the inter-city commuter for $8,995.

Skyhook Production

Cessna's Skyhook helicopter is now in production at the rate of two monthly and approximately seven had been delivered as of last week. Del Roskam pointed out that initial sales on this aircraft probably would have been at a higher level had the company handled them directly from the factory, rather than through its distributor-dealer organization. But the company feels that this latter course will develop the potential better and do better than the factory in the long run.

Among the optional equipment available for 1962 models is an extra seat, costing $95, that for the Model 150 has a capacity of 80 lb., permitting children to be carried. A similar seat for the Skylark, 172 and Skyhawk, has a capacity of 120 lb. Seats can be quickly installed behind the normal seats.

Also available in new models is an electronic single-axis autopilot, produced by its subsidiary, Aircraft Radio Corp. Installed price, complete, for this 9.5-lb. unit is $995. A source close to the project estimates that approximately one-third of all single-engine 1962 Cessnas will leave the factory with this equipment installed. Nav-O-Matic, as the system is trade-named by Cessna, actually is a portion of a series of automatic flight devices programed by the airframe manufacturer—another unit in this family would simply be a wings-leveler device.

Cessna this year is doubling its normal warranty on the aircraft and all factory-installed equipment, providing the customer with free labor and parts service for a six-month period. As one company executive pointed out, since this warranty in some cases may be longer than a supplier's warranty on installed equipment, the airframe manufacturer will tend to be even more critical in the future of reliability of such equipment in its purchases.

PRIVATE LINES

Aero Transportes Wollcopf has been appointed dealer for the Lockheed 60 by Aviones Lockheed-Kaiser of Cordoba, Argentina. Aero Transportes Wollcopf will serve the area around Buenos Aires. The company also is a dealer for Bell Helicopters and Aero Commanders.

National Aero Finance Co., a Cessna subsidiary, has announced new long-term financing plans, which extends finance periods on Cessna Models 310 and 320 to five years, and on single-engine models to four years.

Piper has announced prices for three 1962 models. The Comanche 180 will retail for $17,350 without radio. Prices of the Colt and Apache H will remain as they were for the 1961 models at $4,995 and $37,990, respectively.

Beech Aircraft Corp. has declared a cash dividend of 15 cents per share payable Nov. 1 to stockholders of record Oct. 20. A 2% stock dividend also was declared.

N. O. Brantly, formerly president of Brantly Helicopter Corp., has become chairman of the board of the company in order to devote more time to other business interests. James T. Duffy, Jr., of Frederick, Okla., is president and Jay C. Roberts, formerly of Connecticut Helicopter Corp., Chester, Conn., is new general sales manager. Travelair, GmbH & Co. of Germany has been named Brantly distributor for Sweden, Denmark, Norway and Finland.

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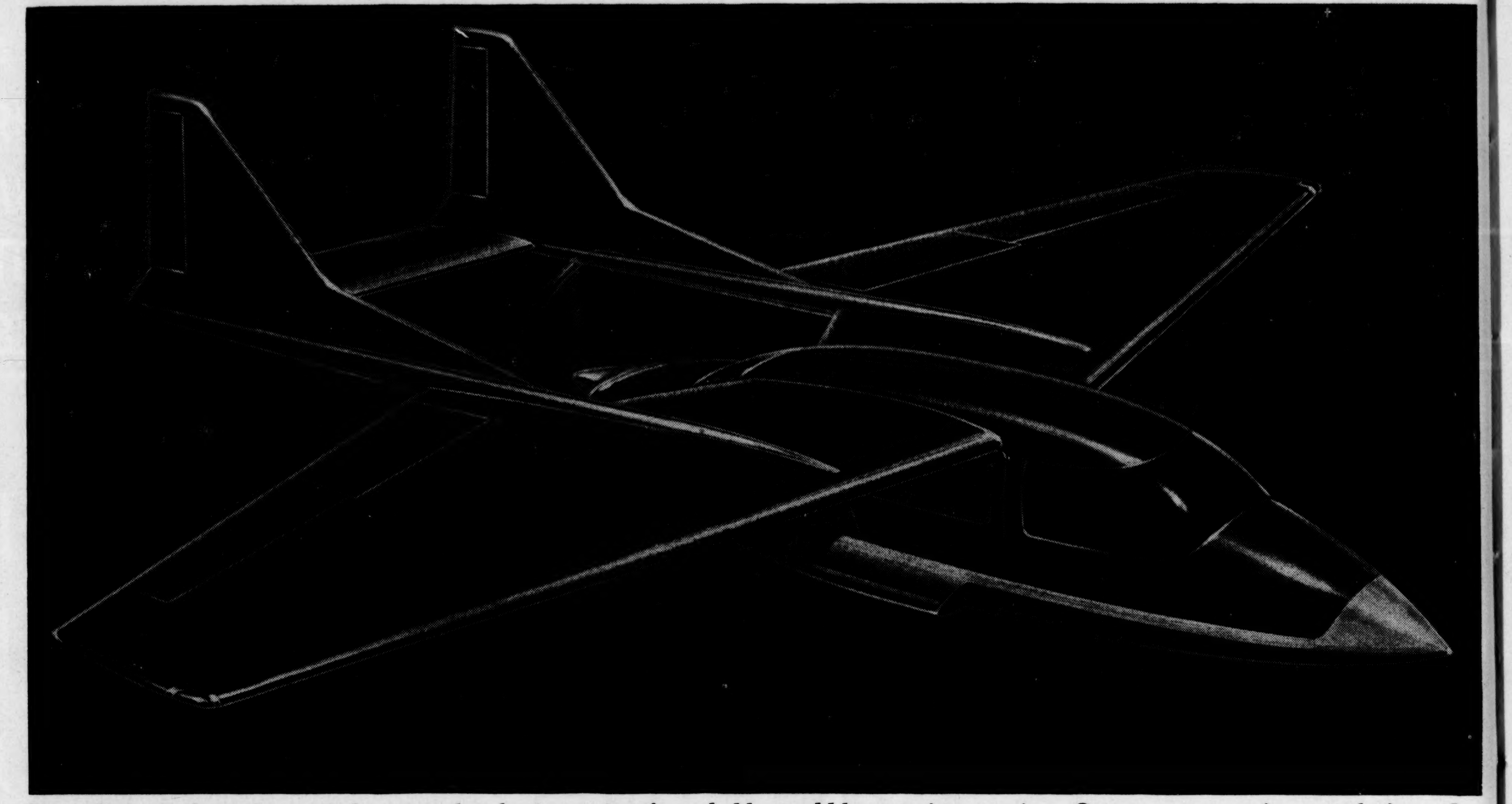
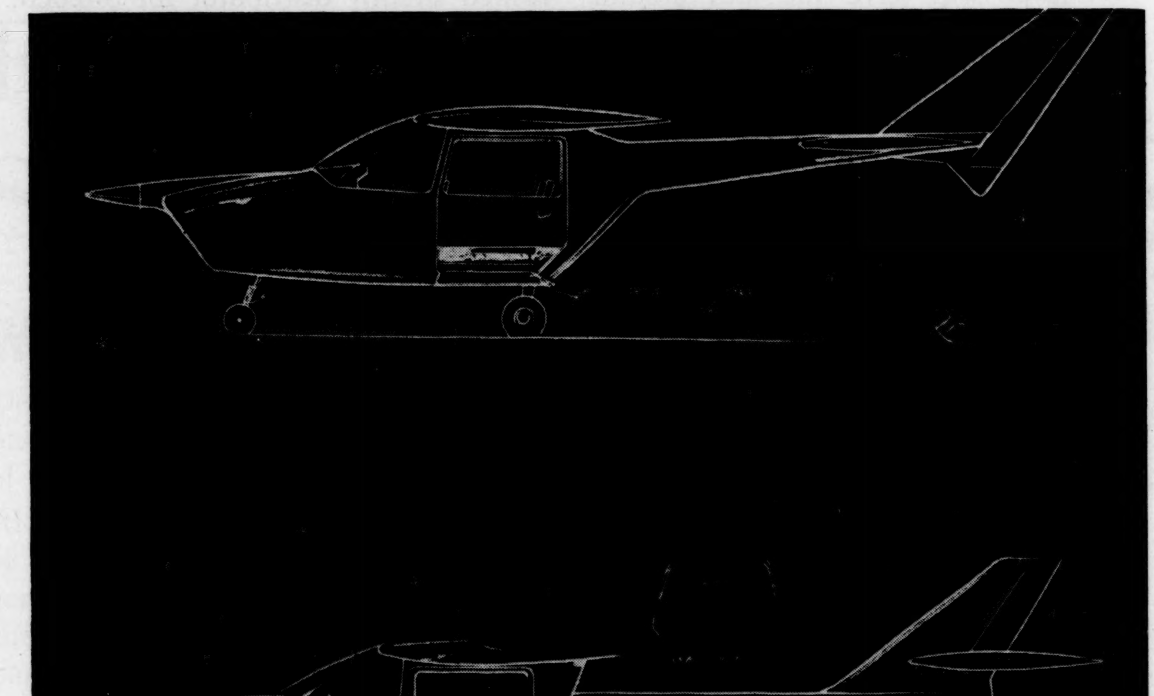


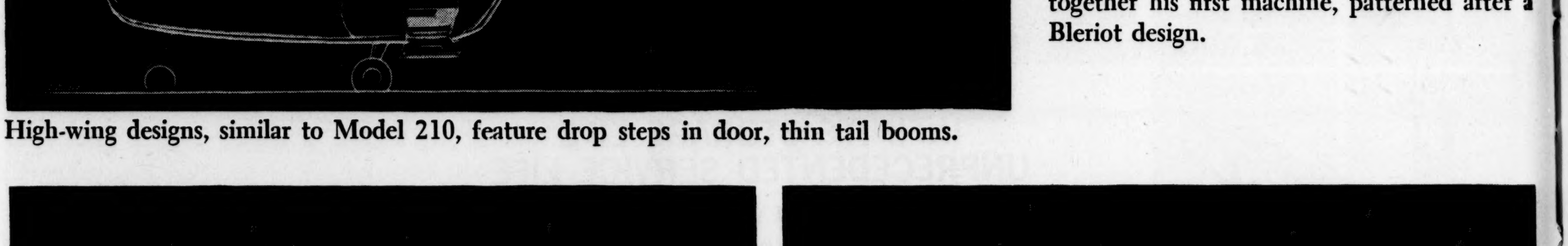
Four-place, single-engine, twin-boom pusher business aircraft probably would have a piston engine. Cessna at present favors turbofan rather than turboprop aircraft, with propeller driven models retaining conventional engines.

Cessna Studying Radical Business Aircraft Designs

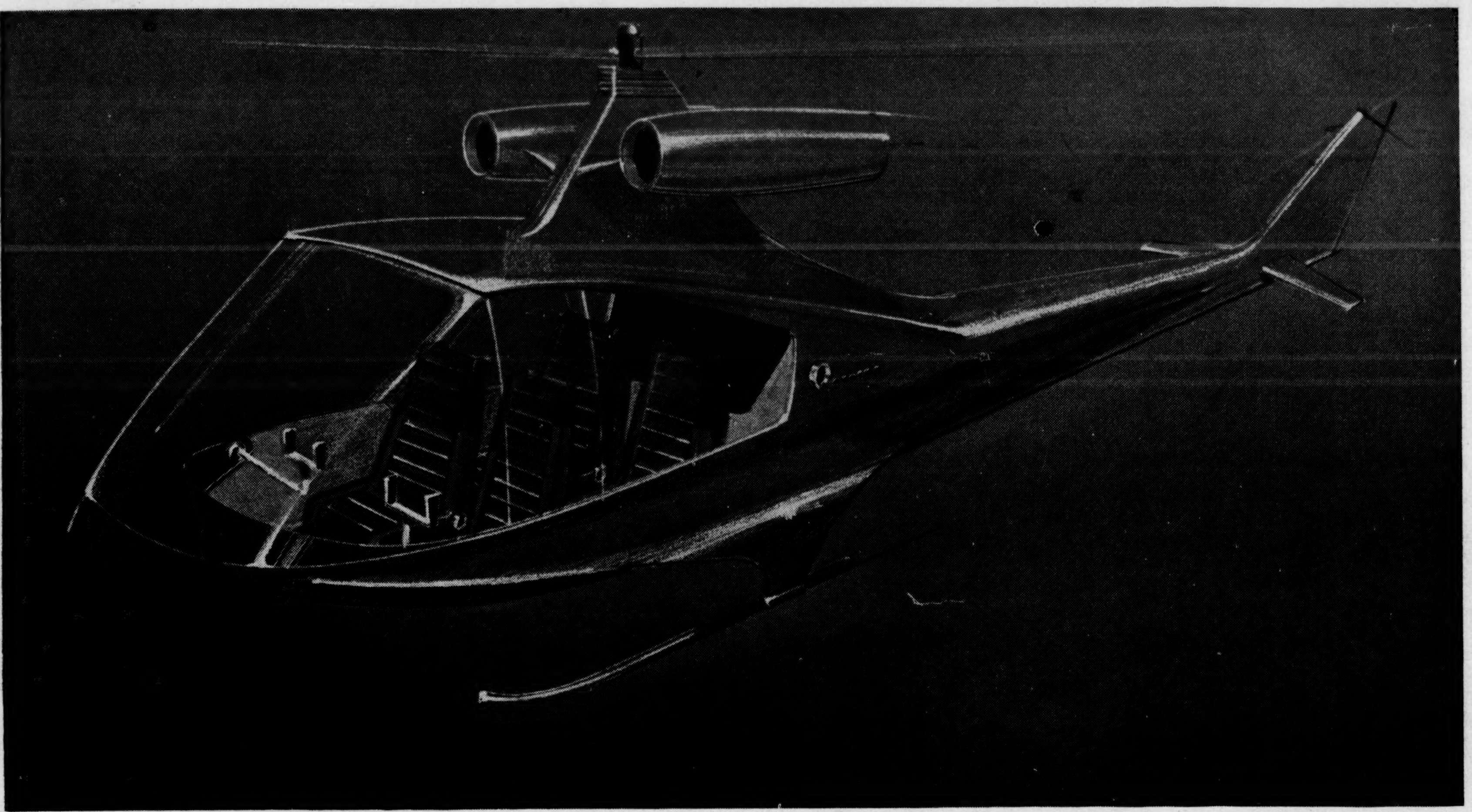


High-wing designs, similar to Model 210, feature drop steps in door, thin tail booms.

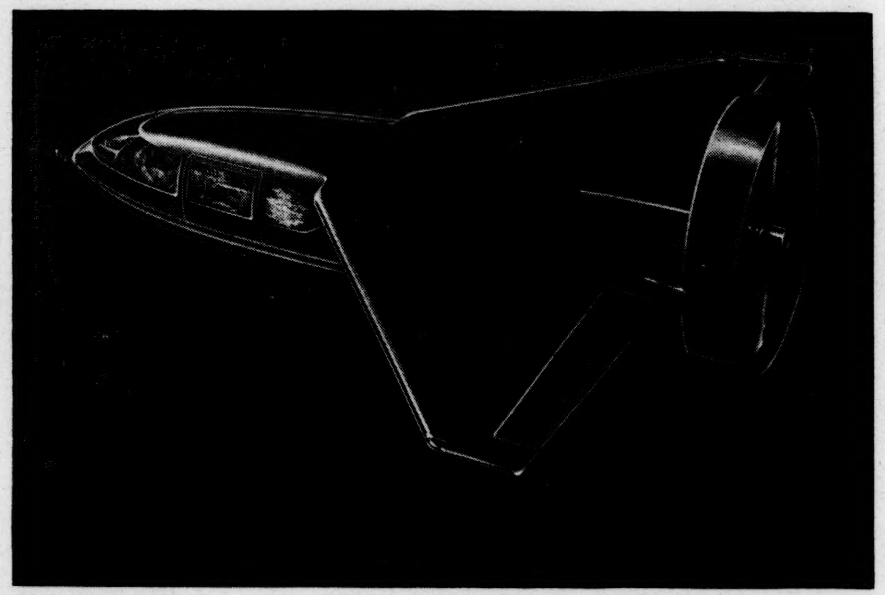
Radical designs in business aircraft, leaning heavily to pusher engine and boom-mounted tailplane configurations, are being studied by Cessna Aircraft Corp.'s engineering department. Also under study are a number of rotary-wing aircraft, including both powered and unpowered rotor systems. Design sketches were displayed during the company's recent distributor-dealer annual meeting in Wichita, Kan. Most of the sketches apparently were "blue-sky" thinking, rather than an attempt at definite projects, but some show resemblance to current models such as the Model 210 and Model 336 which is now in flight test. The display was keyed to Clyde Cessna's first airplane, built in 1911, and was aimed at showing the progress in private plane design made in the 50 years since the company's founder put together his first machine, patterned after a Bleriot design.

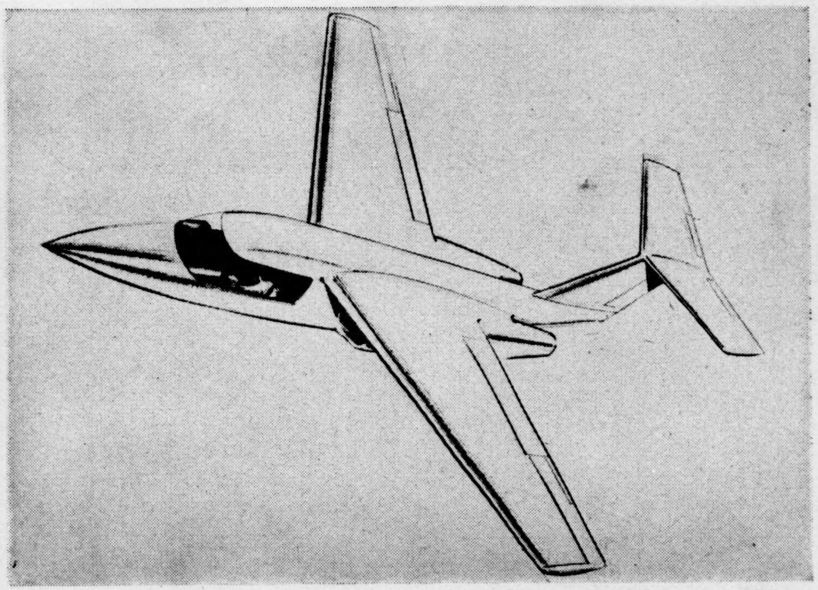


Twin-tail boom designs include single-engine, left, and twin-engine designs. Twin-engine craft features bicycle gear with outriggers.

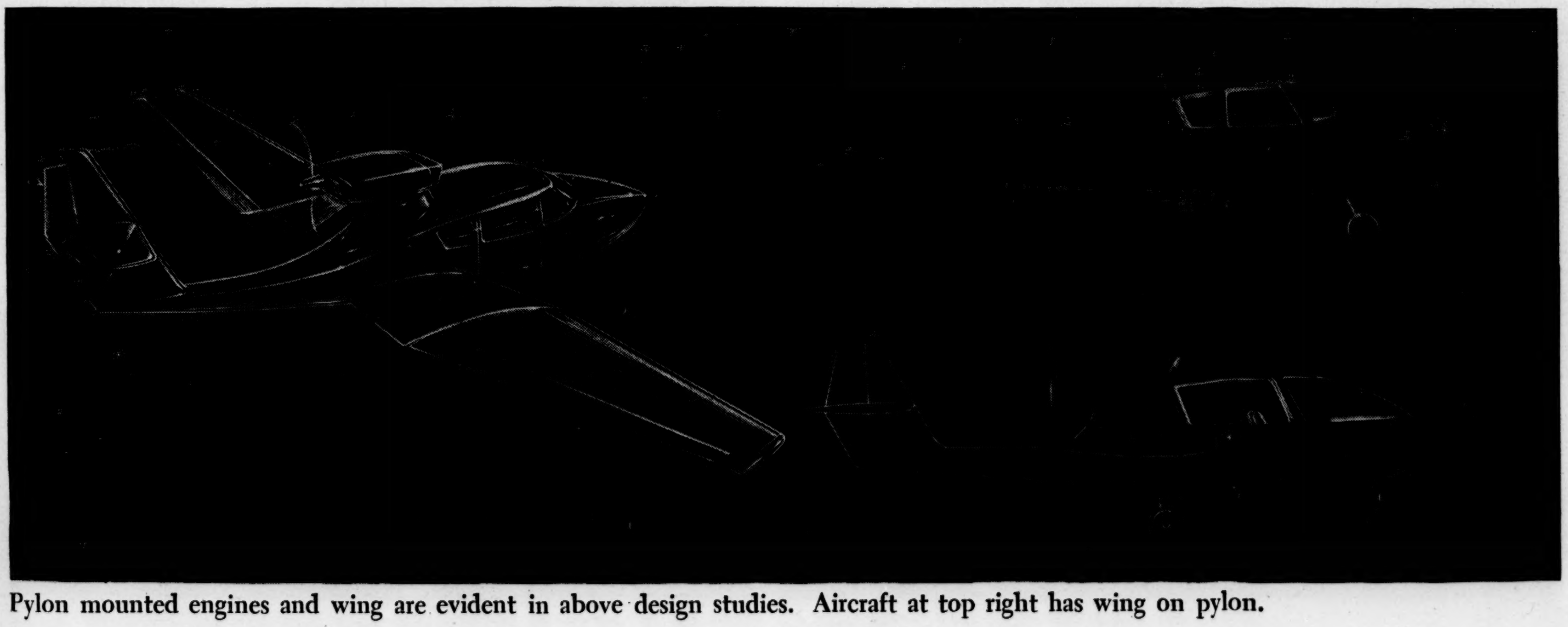


Twin-turbine, four-place helicopter, with engines mounted on rotor pylon, is one of several rotary wing designs under investigation. At present, no engines are available in price range Cessna desires.



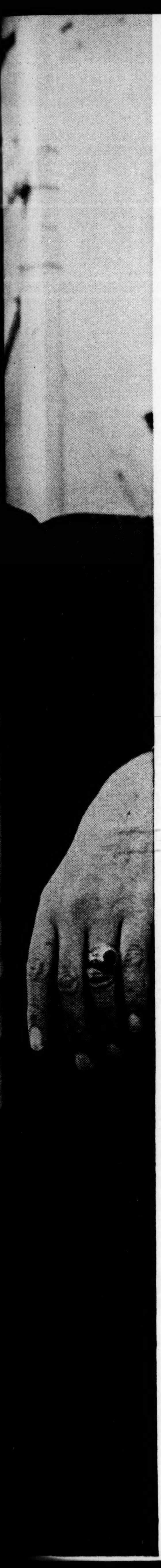


Delta-wing pusher with shrouded propeller is a radical approach to a heavy single-engine business airplane, seating possibly six. Twin-jet, right, has armpit-mounted engines, possibly turbofans, and T-tail.



Pylon mounted engines and wing are evident in above design studies. Aircraft at top right has wing on pylon.

BASIC TEST FOR MEDIA SELECTION



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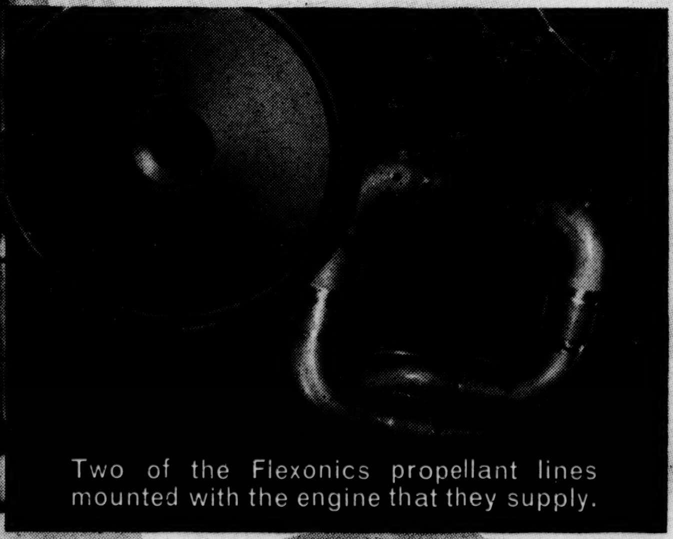
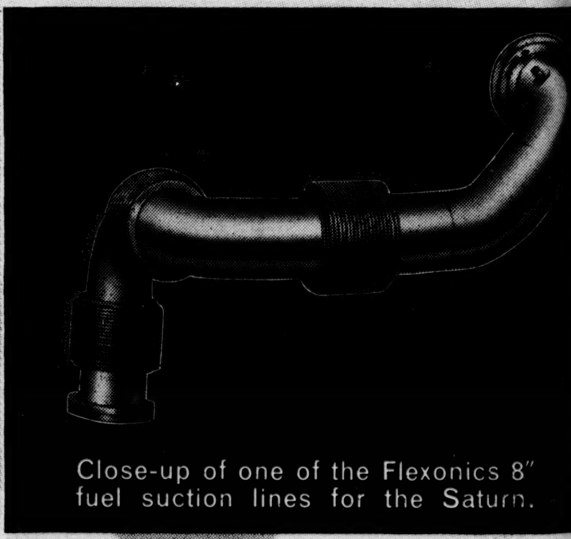


Two of the Flexonics propellant lines mounted with the engine that they supply.



Close-up of one of the Flexonics 8" fuel suction lines for the Saturn.

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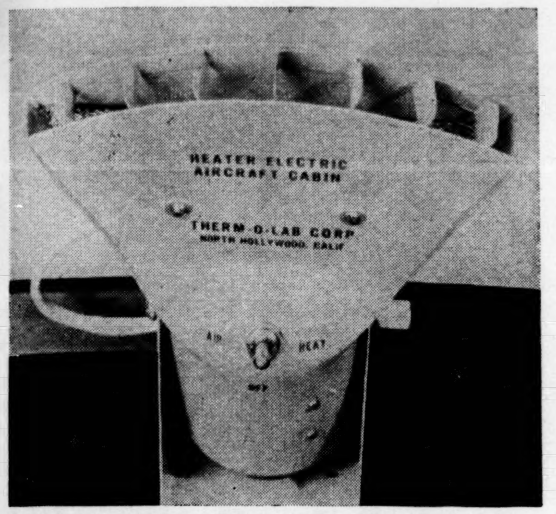
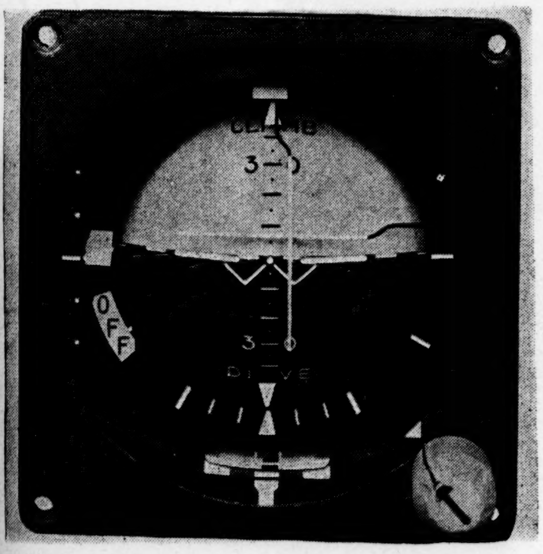


Lightweight Aircraft Heater

Electric blower-heater weighing slightly more than 1 lb. is designed for use as a combination passenger compartment heater and window defroster.

Heater is self-contained with high-speed blower and employs a sprayed-on film type ceramic heating element which does not glow and is controlled by a selector switch. The adjustable base is designed to facilitate directional control regardless of mounting position. The model pictured operates on 12 v.d.c. and draws 30 amp. for small aircraft requirements. These specifications can be changed to meet requirements of other type aircraft or ground vehicles.

Therm-O-Lab Corp., 6940 Farmdale Ave., North Hollywood, Calif.



Flight Director-Attitude Indicator

Visual reference display combines aircraft attitude information with a simply "fly to" reference which is usable with any desired vertical and horizontal flight director commands.

Pitch and roll information is displayed on a two-toned moving sphere. Pitch is shown by movement of the vertical scale on the sphere under the miniature airplane on the indicator. A bottom-mounted scale and pointer show roll attitude, and a ball-type inclinometer displays turn-back information.

Cross-pointers superimposed on the display give "fly to" information. Cross-pointers are moved off the indicator face when the instrument is used only for attitude reference. The instrument also has a glide slope display.

Designated the Lear Model 4055G Flight Director-Attitude Indicator, the instrument features integral red or white lighting, electrical pitch trim and pitch trim fade and power and signal failure warnings flags.

Instrument Division, Lear, Inc., 110 Ionia Ave. N. W., Grand Rapids 2, Mich.

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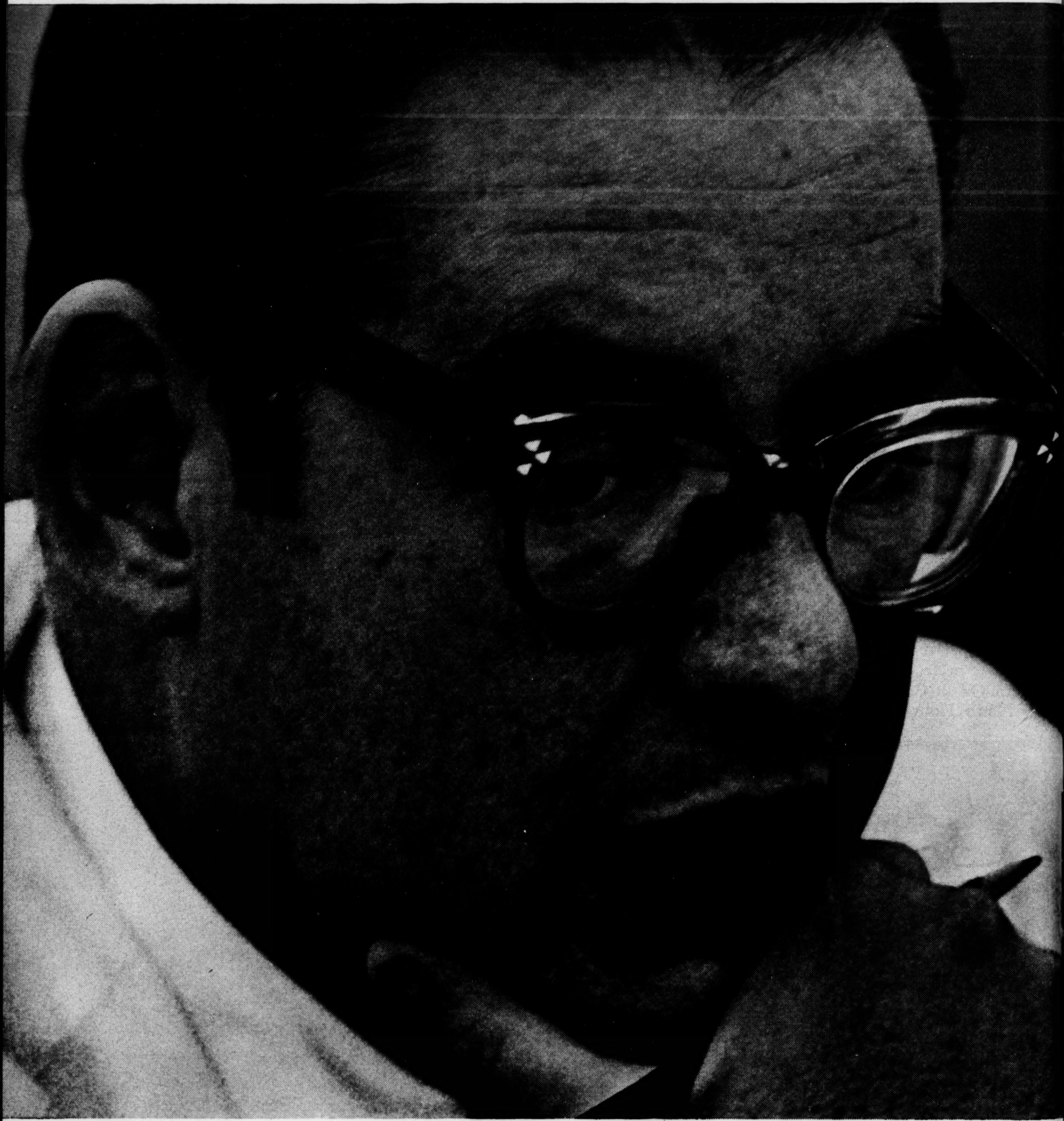

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Pilots Take Firm Stand on Safety Margins

By David H. Hoffman

Chicago—Air Line Pilots Assn. annual safety forum here disclosed that an intensified federal effort to perfect unsophisticated devices and procedures for increasing the air traffic control system's capacity without compromising its safety has won the solid support of U.S. airline pilots.

ALPA air safety representatives attending the three-day session made it clear, however, that pilots were strongly opposed to any new procedures that might reduce safety margins purely for economic or political purposes. This objection, pilots told Aviation Week, might apply to airline attempts to lower turbojet landing minimums and to some noise-abatement procedures that call for steep climbs at reduced power.

Central air safety chairmen for the union cautioned that carriers seeking Federal Aviation Agency approval to land their jets with ceilings as low as 200 ft. and visibilities as low as ½ mi. should first install new equipment. Before jets penetrate ceilings lower than 300 ft. at visibilities less than ¾-mi., their present minimums, aircraft should be equipped with dual autopilot systems and dual approach couplers or flight directors, central air safety chairmen said.

FAA also should require that airports approved at 200 ft. and ½ mi. install instruments to measure very low-level winds and to report runway visual range (RVR).

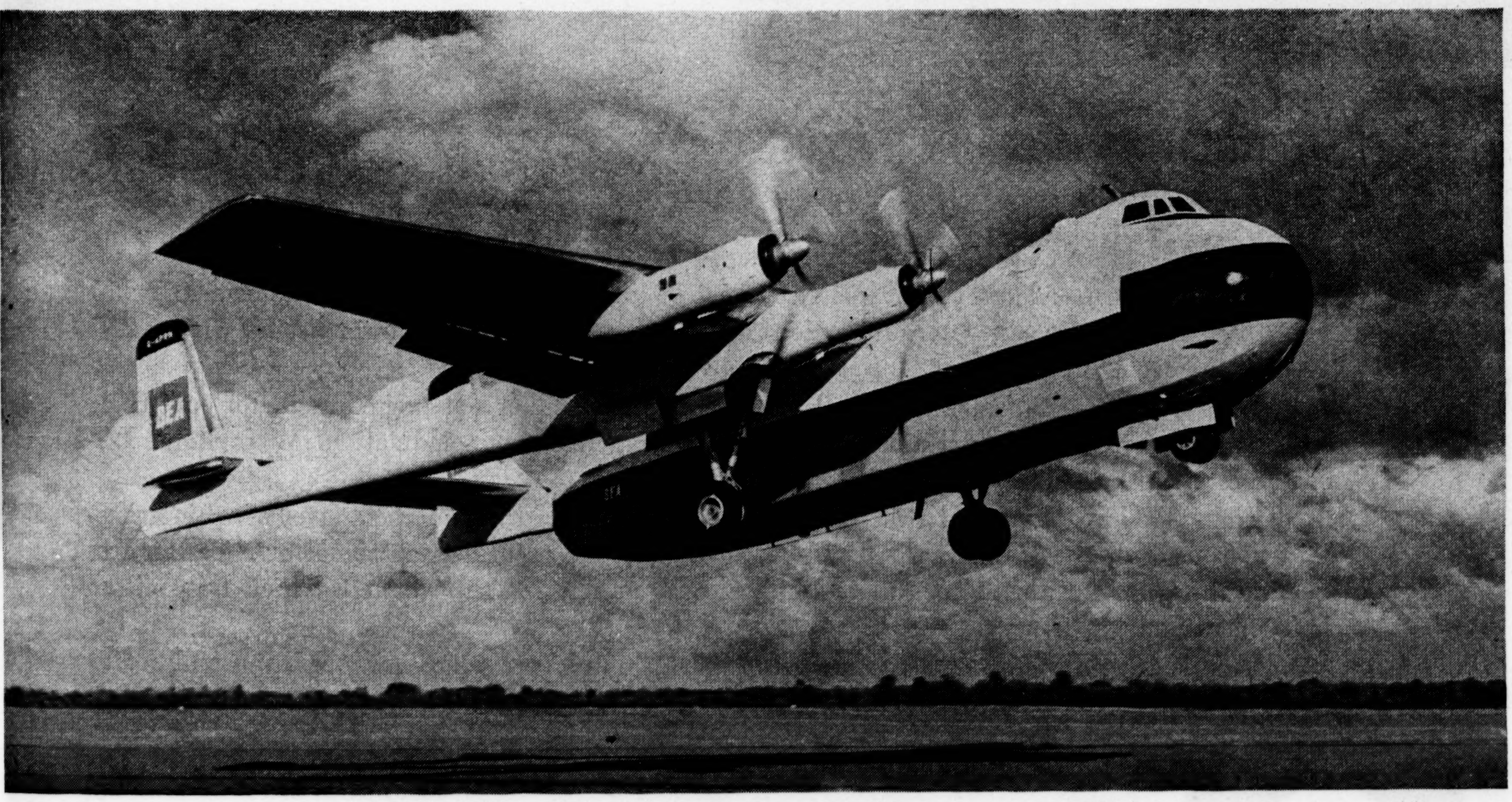
Overwhelmingly, airline pilots here endorsed FAA's insistence on improved instrument or system failure warning devices (AW Oct. 23, p. 37) as a prerequisite for the granting of lower minimums.

The pilots generally conceded that the 26 approved noise-abatement procedures now in use were not inherently dangerous. But they also said that these procedures pushed safety to its outer limit. According to Capt. Harry Clark, central air safety chairman of Trans World Airlines, a Boeing 707 required to climb at V_2 (best climb speed) plus 10 kt. is within 15 kt. of initial stall buffet when turned with 15 deg. of bank. "We are adamant; we will go no further," in following anti-noise procedures that hamper aircraft performance, Capt. Clark told the forum. The problem of noise should be corrected on the drawing boards and not in the cockpit, he said.

Stating that "we've gone as far as possible with noise abatement procedures," J. R. Cram, president of the National Noise Abatement Council, agreed that the problem of lessening aircraft noise has been solved more by pilots than by designers. William Littlewood, vice president-equipment research for American Airlines, added that U. S. carriers pay 5% of their total turbojet fuel bills just to reduce takeoff noise levels by about 12 decibels. But he too agreed that "in some cases, we're on the border of a safe operation."

On the subject of how the flow of air traffic can be safely expedited in the future, Capt. Sam Saint, American Airlines' director of air traffic control, said that FAA now is convinced that it can move more aircraft from a given instrument runway under Instrument Flight Rules (IFR) than under Visual Flight Rules (VFR). Next summer at New York International Airport, Saint said, FAA will demonstrate its ability to increase IFR landing rates by about 30%, thus boosting runway capability to about 50 aircraft per hour.

Lee Warren, deputy director of FAA's Air Traffic Management Service, and Joseph Blatt, newly appointed director of the Agency's Aviation Research and Development Service, described various projects designed to



AW 650s Prepared for Delivery to BEA

First Armstrong Whitworth AW 650 Argosy cargo freighter for British European Airways (AW Oct. 9, p. 48) takes off from manufacturer's plant at Bittewell, Leicestershire. BEA has ordered three Argosies and will schedule them on European freighter operations in November. Airplane also has been ordered by Royal Air Force, and is used in U. S. Logair routes by Riddle.

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eliminate ATC bottlenecks and enhance system safety. They said that current FAA plans call for the following:

- **Blanketing the entire U. S.** with positive control airspace above the 41,000 ft. flight level by March, 1962. Next step will be the lowering of the positive control airspace floor to 24,000 ft., a move FAA hopes can be taken in the Oakland-Sacramento, Calif., area during that same month. Within two to three years, positive control will be extended to cover all U. S. airspace above 24,000 ft. except in Hawaii and Alaska. When necessary ground and airborne equipment exists, this floor will be lowered to 14,500 ft. in non-mountainous areas of the continental U. S.
- **Applying the principle** of positive control to the airspace surrounding major metropolitan terminals. Initial step in implementing terminal area positive control has been taken at Indianapolis, Washington, Idlewild and Atlanta, where FAA uses radar to establish the landing sequence of mixed VFR and IFR flights.

"At the earliest possible time," Warren said, this service will be expanded so that all VFR pilots passing through a particular terminal area make their presence known to ATC. From this base, terminal area control will progress until a system is developed that affords "the highest degree of separation to the greatest possible number of aircraft," Warren said.

- **Increasing use** of radar handoff procedures. Such handoffs, in which an ATC center controller positively identifies a radar target before transferring it to an approach controller, are being accomplished at 11 centers feeding 15 approach control facilities. On a part-time basis, handoffs are made from 14 additional centers to 34 other approach control facilities. Jacksonville Center now is commissioning its radar equipment and soon will become the 26th center in the 48 states to use radar handouts excluding Alaska and Hawaii.
- **Establishing** a National Flight Data Center. This center, which FAA hopes will be operational by early 1962, will support a central flight information service formed to collect, evaluate and disseminate aeronautical data needed by government and the aviation community. This program, already under way, has resulted in joint civil-military agreement on a format for en route low altitude, intermediate altitude and arrival and departure charts. A common high-altitude en route chart also has been developed and its prototype will be distributed for evaluation within two months.
- **Segregating** civil turbojet holding and approach patterns from those of piston-powered aircraft. This procedure has been simulated on computers at FAA's Atlantic City, N. J., test center with encouraging results. Live tests scheduled to begin on Nov. 15 in the San Francisco, Denver and Atlanta terminal areas will furnish further data. If this substantiates the simulation studies, FAA intends to put its segregation policy into effect wherever ATC system capability will permit it.
- **Supplying** the Federal Housing Administration with guidelines for issuing loans to homebuilders in the vicinity of airports. Similar guidelines, designed to plot where noise complaints are most likely to develop, will be forwarded to municipal authorities. As recommended by earlier aviation studies, development of such data would be of value in zoning land bordering an airport and might minimize the need for anti-noise procedures of the type found objectionable by some pilots.
- **Developing** improved Instrument Landing System (ILS) components. To lessen the effect of waves or bends in ILS courses, FAA is working on two new types of localizer antennas (AW May 15, p. 91), a new glide slope transmitter and flush-mounted ILS antenna in general. Should these projects prove successful, and should the British Bleu landing system be made an integral part of U. S. traffic control, the laying of leader cables along the approach to an instrument runway may prove unnecessary.

In a report on other, less advanced FAA safety projects, Theo. G. Linnert, head of ALPA's engineering and air safety department, disclosed that the agency was recommending further research on devices to improve windshield visibility in precipitation, systems to "inert" powerplants to prevent the outbreak of fire after a survivable accident and better in-flight fire warning.

Linnert also said that continuing "underrun" and "overrun" landing accidents have prompted the U. S. Weather Bureau to undertake a study of low level wind behavior. ALPA has contended that "low level jet streams" could be a cause of such accidents, Linnert said. As a result, the Weather Bureau plans to instrument four microwave and television towers to record wind data at four levels between the ground and 350 ft. in the vicinity of Washington National Airport. Reports of abnormal aircraft landings will be cross-checked with wind measurements at that moment. In addition, the agency has begun a long-range program aimed at developing a device that would sense and report a complete picture of weather immediately above an airport's runway, he said.

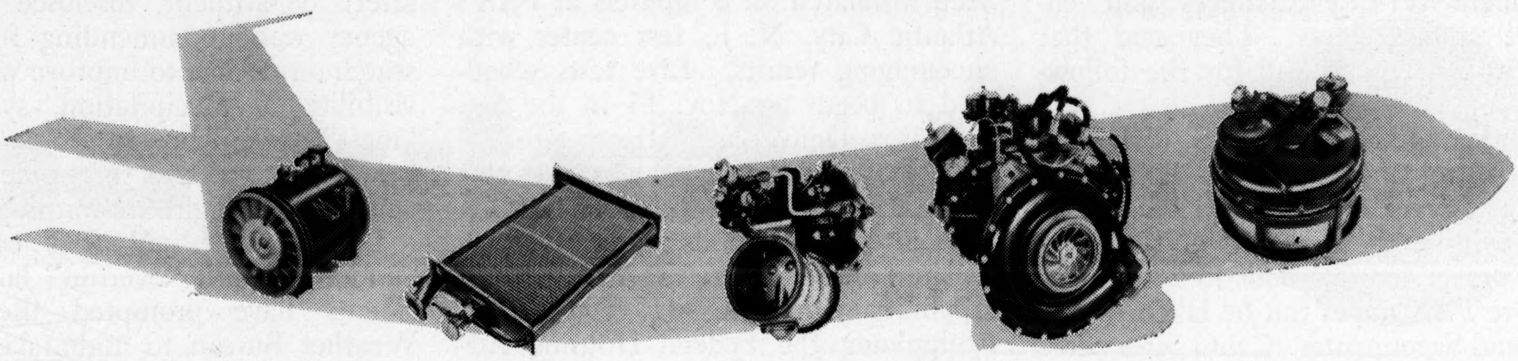
Runway Project

FAA's effort to develop a system of colored lights that would inform a pilot landing or taking off of the runway distance remaining was an "active, short-range project," Blatt reported. By the end of this year, he added, 87 runways will have RVR instrumentation. In 1962, 64 more will get RVR; in 1963, 50 others.

On the subject of fire fighting, Capt.

Test Vehicle Simulates VTOL Aircraft

Maneuverable test vehicle at Northrop Corp.'s Norair Division, Hawthorne, Calif., simulates the yaw, pitch and roll of a 40,000-lb. supersonic VTOL fighter in hovering attitude. The simulator was built so that studies could be conducted on the control power-controllability relationship for all-weather vertical landing and takeoff instrument flight.



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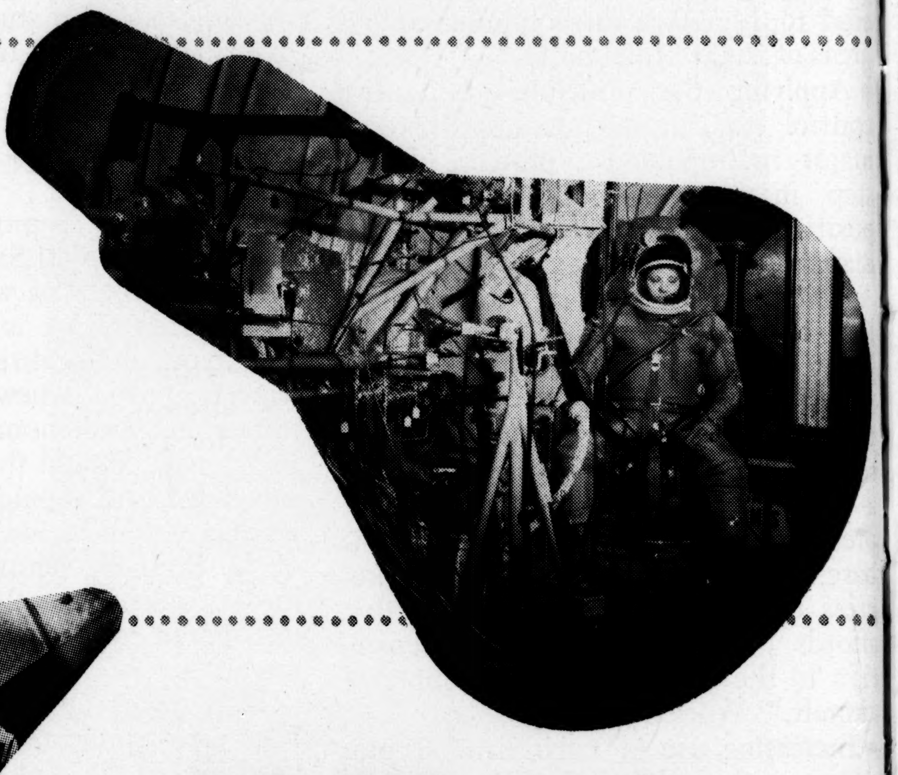

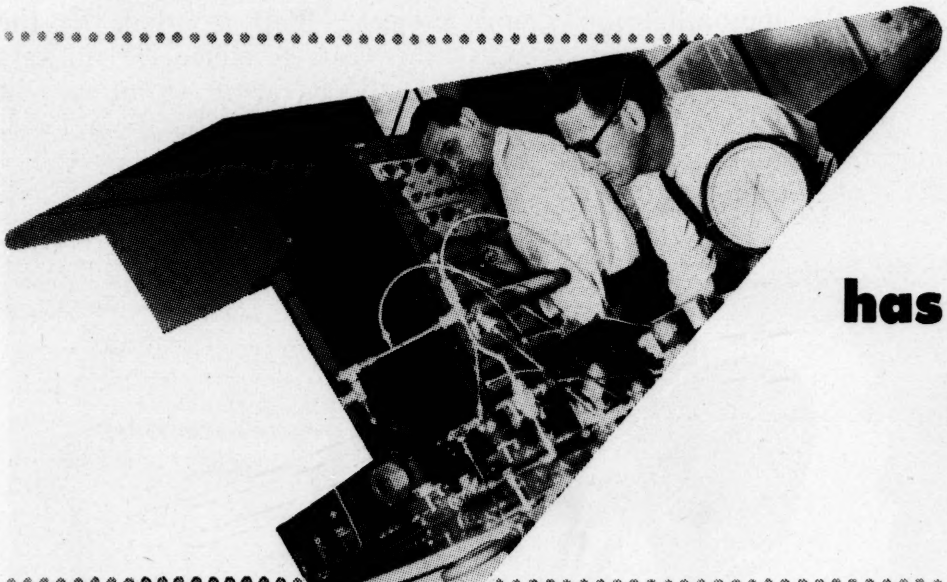

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W. L. Collier, chairman of ALPA's airport rescue and fire committee, reported a sharp increase in the number of U. S. airports rated as having "good protection" since last year's safety forum. Last year, of 162 airports surveyed by ALPA, only 8% had good protection, while 35% had "some protection" and 57% "no protection," Collier said.

This year, by contrast, a survey of 244 airports shows that 12% have good protection, 56% some protection and 32% no protection.

Delta Capt. B. V. Hewes, a member of the rescue and fire committee, emphasized that friction and static sparks account for only about 5% of the fires that follow airline accidents. A far greater hazard, Hewes said, is the turbine engine itself which continues to turn for some time even when thrown clear of the aircraft. Four parts of the turbine—the aft end of the compressor, the combustion cans, the turbine and the tail pipe—retain enough heat to accomplish combustion for up to 45 min. after shutdown. Continued rotation of the engine, moreover, draws in fuel vapor from spillage and ignites it.

Inerting System

Answer to this, according to Hewes, is an efficient water or chemical inerting system. Although such a system was developed about five years ago, the carriers have not acquired it because of the cost and weight, he said. Hewes estimated that 10-12 gal. of water would cool turbine hot spots below ignition temperature.

To cope with recent incidents of hydraulic system malfunctions experienced by U. S. airlines, Hewes urged FAA to establish 10 civil "emergency landing fields" with 12,000- to 14,000-ft. runways. FAA then should equip these airports with complete ground crash-rescue equipment, fire-fighting helicopters and trained first aid and ambulance teams, Hewes said.

Edward H. Cockerham, executive vice president of the Air Traffic Control Assn., said FAA should "concentrate heavily" on an electronic system that would automatically furnish aircraft identification, altitude and position to controllers. As an interim measure pending development of this system, Cockerham recommended that an effort be made to "level off these peaks and valleys of traffic load in high-density areas" by distributing airline departures more evenly around the clock. This, he said, should be accomplished voluntarily if possible but by regulation if necessary.

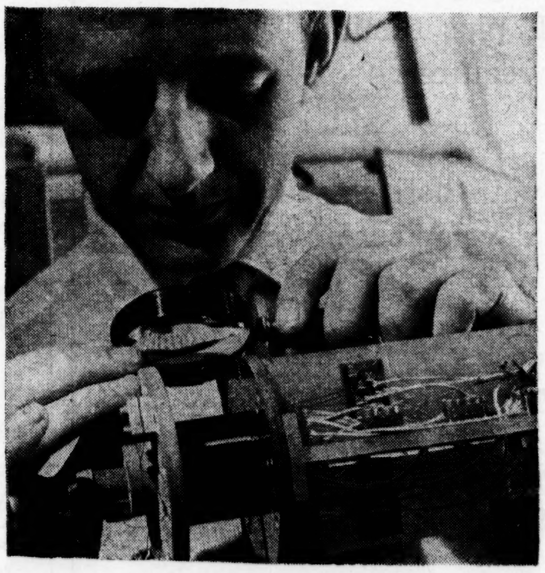
Initial move to determine the economic impact of such action would be the appointment of a committee composed of representatives of all segments of the aviation community. This group would chart the volume of traffic moving into a high-density airport during a peak day, weighing it against the airport's safe acceptance rate and the cost of all delays encountered. Recommendations to decrease peak loads and improve safety would emerge from this study, Cockerham suggested.

Turning to the problems of training airline pilots, Capt. E. R. Watson of Eastern Air Lines, chairman of ALPA's training plans committee, urged that it is unrealistic to require that pilots demonstrate equal degrees of skill in jet transport simulators and jet transports.

"The one major deterrent to some line pilot's acceptance of a good comprehensive training and checking program is the over-zealous, lint-picking actions of some FAA training and checking specialists," Watson charged. Line pilots respond to this "academic" approach by seeking to reduce the time they are exposed to such treatment. The result, according to Watson, is that some pilot groups were too quick in agreeing with Air Transport Assn. that many training and checking maneuvers should be eliminated.

Watson urged ALPA to appeal once again for a copilot Air Transport Rating because, he said, some carriers, with FAA's sanction, are taking strong disciplinary action against captains when their copilots cause an accident.

In a progress report on Project SCAN —System for the Collection and Analysis of Near-Miss Reports—Jerome Lederer, director of the Flight Safety Foundation, said that 1,500 reports were received by his office during the first two weeks of the "non-punitive" program initiated by FAA Administrator N. E. Halaby. Some of these, Lederer said, were two to three years old. Of total reports received, 24% were written by airline pilots, 37% by military pilots and 39% by general aviation pilots.



Superconducting Magnet

Superconducting magnet, called most powerful ever built for its size and weight by Westinghouse Electric which developed it, produces 43,000 gauss. Magnet, which is operated at —450F in liquid helium, contains about ½ mi. of wire, 10 mils in diameter, made of niobium-zirconium alloy.

Flight Safety Foundation classification indicates that 56% of the reports involved a "potential hazard," while 21% involved a "critical hazard." Pilots operating under some form of ATC control, frequently radar, wrote 67% of the total reports, Lederer reported. A large majority of the near-misses occurred in clear weather during daytime.

On this subject, W. B. Becker, director of operations for ATA, said that private pilots' "apparent disregard" for ATC rules was the prime safety hazard faced by local service carriers today. Flying at night without lights and flying VFR in IFR weather were the two most serious offenses listed by Becker.

ATC Efficiency

Capt. E. J. Bechtold, of ALPA's ATC committee, Capt. David S. Little, chairman of ALPA's all-weather flight committee, and Capt. John F. Gill, director of flight safety for Eastern Air Lines, put forward a series of recommendations on how to boost ATC efficiency and pilot safety. FAA or the airlines, these speakers said, should:

- **Develop a precise** instrument to aid pilots in rotating their jets on takeoff. Present instrumentation and pilot failure to rotate probably have caused "seven or eight" recent accidents, Gill said.
- **Simplify the manner** in which jet autopilots and approach couplers are controlled. According to Capt. Little, a method must be devised to enable a pilot to couple on an ILS course, whether his aircraft is above or below glide slope, after he has turned to final approach at anything less than a 90-deg. angle by "one simple control movement."
- **Reduce the complexity** of ATC departure clearances and allow pilots more time after takeoff before ordering them to change radio frequencies. "Judicious use of the civil Standard Instrument Departure procedures" should provide a measure of relief, Capt. Bechtold said. Teaching ATC personnel the performance characteristics of various aircraft would help solve the "change frequency" problem, he added.
- **Eliminate all** compulsory reporting points along en route airways to hold down communications workloads. Because pilots must monitor ATC frequencies at all times, Bechtold said, controllers could interrogate pilots for required position information. He estimated that this practice would cut routine voice communication by about 50%.
- **Call a halt** to the testing of Century-series jet fighters and other high performance military aircraft in congested terminal areas.

Control and Instrumentation Engineers

A key research and development program is now underway at Atomics International to design long-life, compact, lightweight nuclear reactors that will provide auxiliary power systems for space applications. Many interesting problems exist to challenge electrical engineers who want to relate their present experience to reactor technology in any of the following areas:

FLIGHT INSTRUMENTATION DESIGN
Electrical control system design and/or aircraft or missile flight instrumentation design. Will establish flight instrumentation requirements, block diagrams for flight and test systems, preliminary specifications for each instrument or subsystem.

TELEMETRY
Responsible engineers to analyze, plan and specify the telemetry required to ascertain the performance of nuclear power plants during space tests. The individuals must have experience in missile instrumentation and telemetry of temperature, vibration, acceleration, etc. BS or MSEE preferred.

CONTROL ANALYSIS
Dynamic and control analysis including system start-up and full power operation. BS or MSEE plus familiarity with latest analog and digital techniques required.

CIRCUIT DESIGN
Electronics engineers experienced with both vacuum tube and magnetic devices to design and develop control circuits for compact nuclear power plants.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

For specific details write: Mr. J. X. Newton, Personnel Office, Atomics International, 8900 DeSoto Avenue, Canoga Park, California.

ATOMICS INTERNATIONAL
DIVISION OF NORTH AMERICAN AVIATION

WHO'S WHERE

(Continued from page 23)

Changes

Roy E. Pryor, manager-MF295 engine project, General Electric Co., Cincinnati.

Robert A. Kirkman, staff engineer, Electronic Design Integration Department, Space Technology Laboratories, Inc., Los Angeles, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc.

Harold Rind, chief of Republic Aviation Corp.'s Space Environment Laboratory, Farmingdale, N.Y.

Dean P. Stowell, assistant to the vice president-general manager, Boeing's Aero-Space Division, Seattle, Wash.

Ralph V. O'Brien, customer service representative-Washington, D.C., for the Electronic Equipment Division of McDonnell Aircraft Corp.

Raymond F. Crisp, manager-aerospace contracting, Aerospace Communications and Controls Division, Defense Electronic Products, Radio Corporation of America, Burlington, Mass.

Raymond W. Meyer, director of quality assurance, Eitel-McCullough, Inc., San Carlos, Calif.

Arthur E. Cooper, manager of research and engineering, Federal Systems Division, International Business Machines Corp., Rockville, Md., and **Raymond A. Soderberg,** director of operations planning.

Ralph W. Elsner, engineering manager, Western Center, Motorola Military Electronics Division, Scottsdale, Ariz.

Raymond Trapp, general sales manager, Bendix Products Aerospace Division, South Bend, Ind.

Dr. Joseph M. Brown, associate department head, Vehicle Systems Department, Systems Research and Planning Division, Aerospace Corp., Los Angeles, Calif.

Harold L. Flowers, general manager of engineering, Electronics Operation, Avco's Electronics and Ordnance Division, Cincinnati, Ohio.

Warren E. Racine, assistant to the general manager, Traid Corp., Encino, Calif.

Howard F. Marx, director of corporate planning, Ling-Temco-Vought, Inc., Dallas, Tex.

William R. Boyd, III, director of aviation and government sales, Cities Service Co., New York, N.Y.

Rolf D. Weglein, head-product development, Hughes Aircraft Co.'s Microwave Tube Division, Culver City, Calif.

Dawson E. Teaford, administrative assistant to the president, Bourns, Inc., Riverside, Calif.

Dr. Harry E. Weaver, manager-optical pumping and cryogenics research, Varian Associates' Instrument Division, Palo Alto, Calif., and **Dr. James T. Arnold,** manager-research in geophysics and space physics.

John C. Stobo, assistant manager, Raytheon Co.'s Aero/Weapons Division, Lexington, Mass. Mr. Stobo continues as manager of the Division's Airborne Equipment Operation.

George A. Warde, general production manager, American Airlines' Tulsa, Okla., Maintenance Base. **Bonnie V. Nabors** succeeds Mr. Warde as manager-production scheduling and control at Tulsa.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, NOVEMBER 6, 1961

AER-O-COM 106
AMERICAN AIR FILTER COMPANY INC., DEFENSE PRODUCTS DIVISION 57
AMERICAN AIRLINES, INC 44
AMERICAN MACHINE & FOUNDRY COMPANY, GOVERNMENT PRODUCTS GROUP 18
AMERICAN TELEPHONE & TELEGRAPH COMPANY 58
ATOMICS INTERNATIONAL, A DIVISION OF NORTH AMERICAN AVIATION, INC 110
AVIATION WEEK & SPACE TECHNOLOGY 100-101

BENDIX COMPUTER DIVISION, THE BENDIX CORPORATION 64
BENDIX PIONEER CENTRAL DIVISION, THE BENDIX CORPORATION 80
ENDIX PRODUCTS DIVISION, THE BENDIX CORPORATION 13
ENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 24
OEING COMPANY, THE 48
RUSH INSTRUMENTS DIVISION, CLEVITE CORPORATION .... 3rd Cover

HERRY RIVET DIVISION, TOWNSEND COMPANY 66
OLLINS RADIO COMPANY, CEDAR RAPIDS DIVISION 53
ONTINENTAL MOTORS CORPORATION 5
ONTROLS CORPORATION OF AMERICA, CONTROL SWITCH DIVISION 12

eHAVILLAND AIRCRAFT OF CANADA LIMITED 35
EL MAR ENGINEERING LABORATORIES 96
EUTSCH COMPANY, THE—HYDRAULIC COMPONENTS 7

AIRCHILD SEMICONDUCTOR CORPORATION 20
ENWAL INCORPORATED 102
LEXONICS DIVISION OF CALUMET & HECLA, INC. 75
LUIDYNE ENGINEERING CORPORATION 62

ARRETT CORPORATION, THE—AIRESEARCH MFG. CO. 108
EMCO, INC., A SUBSIDIARY OF THE HUPP CORPORATION 95
ENERAL DYNAMICS/FORT WORTH 86
ENERAL ELECTRIC COMPANY, LIGHT MILITARY ELECTRONICS DEPARTMENT 17
ENERAL PRECISION, INC 14-15
OODYEAR AIRCRAFT CORPORATION, THE 3

UGHES AIRCRAFT COMPANY 78-79, 85

TERNATIONAL NICKEL COMPANY, INC., THE 16

AYNAR MANUFACTURING COMPANY, INC., KAYLOCK DIVISION .... 2nd Cover

VELLE AIRCRAFT CORPORATION 103
NG-TEMCO-VOUGHT INC., ELECTRONICS DIVISION .... (
ONEL CORPORATION, THE 10
QUIDOMETER CORPORATION, THE 82
TTON INDUSTRIES, INC 63
TTON SYSTEMS, INC., GUIDANCE & CONTROL SYSTEMS DIVISION 92
CKHEED MISSILES & SPACE COMPANY DIVISION OF LOCKHEED AIRCRAFT CORPORATION 60-61

M & T COMPANY, THE 81
MAGNAVOX COMPANY, THE—GOVERNMENT & INDUSTRIAL DIVISION 68
MARQUARDT CORPORATION, THE 72-73
McCORMICK-SELPH 87-88
McGRAW-HILL BOOK COMPANY, INC 119
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, PRECISION METER DIVISION 4

NORTHROP CORPORATION 104

PARSONS COMPANY, THE RALPH M 11
PRATT & WHITNEY AIRCRAFT DIVISION, UNITED AIRCRAFT CORPORATION 46

RCA SERVICE COMPANY, A DIVISION OF RADIO CORPORATION OF AMERICA 66
RAYTHEON COMPANY, EQUIPMENT DIVISION 50-51
REPUBLIC AVIATION CORPORATION 22
RYAN AERONAUTICAL COMPANY 36

SHELL OIL COMPANY 77
SPACE GENERAL CORPORATION 70
SPACE TECHNOLOGY LABORATORIES DIVISION OF THOMPSON RAMO WOOLDRIDGE INC 56
SPERRY UTAH COMPANY DIVISION OF THE SPERRY RAND CORPORATION 9
SYLVANIA ELECTRIC PRODUCTS, INC., SPECIAL PRODUCTS DIVISION 49

TABER INSTRUMENT CORPORATION, AEROSPACE ELECTRONICS DIVISION 71
TITANIUM METALS CORPORATION OF AMERICA 8

UNITED TECHNOLOGY CORPORATION, A SUBSIDIARY OF UNITED AIRCRAFT CORPORATION 90-91

VARIAN ASSOCIATES, BOMAC LABORATORIES .... 4th Cover

WIGGINS OIL TOOL COMPANY, INC., E. B 97

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 111-117
EQUIPMENT
(Used or Surplus New)
For Sale 117

ADVERTISERS INDEX

Boreas Corporation 118
Cornell Aeronautical Lab., Inc 116
General Electric 113
I B M Corp 117
Ling-Temco-Vought Inc. 112
Pacific Propeller, Inc 118
Pratt & Whitney Aircraft 115
Sikorsky Aircraft 112
Solar Aircraft Co. 111
Stoltzfus Agency, Chris D 118
Thiokol Chemical Corp 114

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LETTERS

Cost of Procurement

I recently read in the minutes of a NASA-industry briefing, an address by H. H. Koelle, Director of Future Projects at Huntsville. In this talk, Mr. Koelle states:

"It is our intention to award approximately 28 contracts in the $50,000-$200,000 range on 14 projects. For each contract some 10 to 20 qualified companies will receive an invitation for proposals."

Now, if 28 contracts are to be let, with an average of 15 bidders each, that amounts to 420 proposals. Assuming $5,000 total sales cost per proposals (not high for proposals averaging $100,000), this amounts to $2.1 million in contractors' sales costs to procure the 28 contracts. At an average value of $100,000 each, the total value of the contracts would be $2.8 million.

Thus, the companies will spend $2.1 million to obtain $2.8 million worth of business. It is a mistake to assume these sales expenses will come "out of pocket," since profit margins in government work simply don't provide any "pocket."

Mr. Koelle is known to be both a highly proficient engineer and a highly responsible manager, and we can consider his office as typical of a well managed government research and development agency. If we consider the thousands of similar offices throughout NASA, DOD, AEC and other research and development agencies, we are forced to wonder how little of the government research and development dollar actually finds its way into the laboratory.

I think we have created a procurement situation which leads not to free competition, but to ruinous competition—ruinous to the engineering profession, ruinous to the corporations serving the defense effort, and ruinous to the defense research and development effort itself. The many solutions which have been offered to solve this dilemma deserve more consideration at the highest levels of our government.

Richard L. Mela
Cambridge, Mass.

West Ford Comments

The orbiting of Project West Ford is not a great mistake, it is a national tragedy. In the first place it serves no useful purpose. The United States has several sound, responsible communications satellite programs in Advent, Courier, Echo, and the private communication satellite proposals. West Ford will not handle any duties not handled by the others.

It will, however, do distinct harm to other space programs. The finely-ground lenses of Midas, Samos, Tiros, and Nimbus would be appreciably damaged in collisions with the needles. Also in danger is the delicate externally mounted instrumentation in deep-space and other probes. But worst of all is the black eye it gives to the nation's space program. The irresponsibility of this stunt is plainly evident to many foreign observers who formerly had faith in American scientists. I recall that a few years ago many Americans were worried about irresponsible and damaging Russian space stunts. It is a bitter disappointment that we are the first to become careless. Our initiative may also give the Russians the incentive to try far more damaging tricks than West Ford.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

In the future we shall have to be more careful than ever in order to restore free-world confidence in our "sound" space program. I plead very earnestly that we never again deliberately orbit artificial meteorites.

Frederick Pilcher
Lawrence, Kan.

Space Enthusiasm

I want to reach the moon! I'm curious.

This just about sums up what I see in a space economy. Many things must be meshed together to see a country like ours or Russia place such emphasis on space exploration, and actually spend money doing it. It is tied in with war making, large scale exploration, large scale competition and a standard of living that can support such an undertaking, plus from an engineering standpoint that it is "feasible" and not just wishful daydreaming.

I am an engineer and I get a great deal of real happiness out of putting something together, and to find it works somewhat similar to the way I have figured it out beforehand on paper. It is a sense of accomplishment. But my interests go much further than that! I love research for the same reasons and space work is even further out. It even ties in with religion and why man is on this earth. Are we the only beings in existence? Are we possibly the starting of life in the Universe? If such things are in the timetable of men on this earth, nothing will stop us from expanding out. If this is our future, let us hope that it will not need to be interrupted by our puny little wars.

Space competition can take the place of war, as long as space enthusiasm holds up. All the people of our country who have an interest in space can feel they are a part of this big exploration team. We are all helping to pay for it. Man has always looked at the stars and wondered about them, and the only way science (and, incidentally, our standard of living) has advanced was when he was able to do something about it. Witness the state of our technology, which has only occurred within a few hundred years, compared with the known existence of man for thousands of years previously.

It is not to be denied that wars have helped and accelerated the state of science technologies under the impetus of self-preservation and competition (these words might almost be considered synonymous).

There may be some tightening of belts to support the space effort of this country but our economy can support it. This tighte ing of belts may be entirely illusory becau people will work harder and accompli more and also have a higher standard of l ing than if it were not happening. W would rather not have another WPA.

Warren H. Flar
Electronics Engine
San Diego, Calif.

Helicopter Simplicity

Sen. Monroney advises underdevelop nations to avoid spending millions of d lars for highways and to go "directly fro the buffalo cart into the air age for conne ing their country."

Could he, your editors, or anyone e explain why the aircraft industry and, p ticularly, the helicopter people (what e can be used in rough terrain?) get little encouragement to pursue simpler co ponents in order to make this practic Why, for example, do we not read th money is being spent for elastic blade tentions to replace the troublesome du vulnerable hinges in helicopter rotor hea (AW May 29, p. 19).

If the fraction of research in the a of such simplification studies were express as a percentage of total airspace researc it probably would have as many zeros front as the Moondoggle Program c figure will have at the end.

William H. Raser,
Stratford, Conn.

Moral Wisdom

I read the letter by Mr. F. W. Kro (AW Sept. 18, p. 108) which criticized yo magazine in somewhat intemperate term I know McGraw-Hill need not be defend against such wild diatribes, but I would li to commend the editorial in question. Yo editorial simply touched lightly and gent upon the historical facts.

I, for one, do not relish the spectacle fered by German scientists in this count who take it upon themselves to offer publ advice and counsel upon matters of mora ethics, theology and public weal. If M von Braun and Mr. Krohn (to name a fe are so adept and so swift at self-expressi in non-technical areas, why were they silent in those areas in the decade prior 1945?

Those German scientists who came to th country after 1945 were at best passive in period of colossal bestiality perpetrated b the German people—and the guilt is plura although not even Eichmann admits to sha ing any of it.

The technical wizards who designed th V2 and Cyclone B are now free to ply th talents in our military establishment, bu we who do not relish the association nee not acknowledge their gifts for leadership social and moral areas.

Denis Brasket
Engineer, missile industr
Culver City, Calif.